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AUTHOR Morris, June E.; Nolan, Carson Y.
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ABSTRACT

Four interim progress reports describe various aspects of the Aural Study Systems for the Visually Handicapped research project, designed to explore processes involved in aural learning by the blind and to develop an entire system of study using recorded texts. Prior to development of hardware and specifications for software for such a system, a task analysis of the processes actually involved in aural learning was undertaken to obtain necessary information for the study system development. This task analysis is reported in the first interim progress report. The second report describes an analysis of textbook content to determine a format for most efficient use of recorded material, and analysis of study techniques of sophisticated students currently using aural material for study purposes. Results of a study designed to test the effects of varying motivation and word rate on comprehension are presented in the third report. The fourth report, discussing some parameters of learning by listening, covers research dealing with amounts of time and distribution of practice in aural study as study variables affecting learning through listening. (KW)

INTERIM PROGRESS REPORTS

Project No. 8-0046
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AURAL STUDY SYSTEMS FOR THE VISUALLY HANDICAPPED

No. 1 A Task Analysis

No. 2 Recorded Textbook Formats and Aural Study Methods: A Summary of User Opinions

No. 3 Effects of Motivation and Word Rate on Aural Comprehension

No. 4 Some Parameters of Learning by Listening

June E. Morris and Carson Y. Nolan
American Printing House for the Blind, Inc.
1839 Frankfort Avenue
Louisville, Kentucky 40206

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Department of Health, Education, and Welfare
U. S. Office of Education
Bureau of Education for the Handicapped

Interim Progress Report

No. 1

Project No. 8-0046

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Aural Study Systems for the Visually Handicapped

A Task Analysis

June E. Morris and Carson Y. Nolan

American Printing House for the Blind, Inc.

Louisville, Kentucky

15 August 1970

The research reported herein was performed pursuant to a grant with the Bureau of Education for the Handicapped, U. S. Office of Education, Department of Health, Education, and Welfare. Contractors undertaking such projects under government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official position of the Bureau of Education for the Handicapped.

Department of Health, Education, and Welfare

U. S. Office of Education
Bureau of Education for the Handicapped

One of the goals of the research project undertaken by the American Printing House for the Blind (APH) entitled Aural Study Systems for the Visually Handicapped was to develop the hardware for such a system and determine specifications for the software to accompany it. Phase one of the hardware development was to concern discs; phase two tapes. The reason discs were given priority over tapes was because discs were the medium in which Talking Books were being produced at the time the study was undertaken and the medium in which APH had the capacity for mass production. The hardware for phase two might be of either the reel or cassette type depending, in part, on the state of the art of the latter. Specifications for the software to accompany either phase would be similar.

More specifically, the purposes of the phase of the Aural Study System project reported here was to gain information that could be used (1) to build a disc player specifically designed to be used for study purposes as opposed to existing players designed for recreational listening, (2) to modify and improve the Talking Book Reproducer, (3) to improve current recording methods, (4) to provide information for the editing of textbooks to be recorded, (5) to examine format for recorded texts, (6) to determine guidelines for readers, (7) to write an instructional manual concerning study techniques best suited to aural study, (8) to identify problems in the use of recorded texts, and (9) to identify types of information not amenable to aural presentation.

Prior to working with tangibles it was necessary to learn the processes actually involved in the job of studying from aural materials. In order to do this, a task analysis of this process was undertaken.

Method

Initially, information gained during student interviews (Nolan, 1966) was reviewed. These interviews were directed at learning how blind students who were accustomed to using recorded materials actually used these materials. This information provided guidelines for the subsequent analyses undertaken.

A job analysis technique was used to determine the tasks involved in the job of studying from recorded materials. There are three parts to the analysis of any job (Department of Labor, 1944). "(1) The job must be completely and accurately identified; (2) the tasks of the job must be completely and accurately described; (3) the requirements the job makes upon the worker for successful performance must be indicated. [p. 1]."

The authors undertook the job of studying from recorded texts in order to analyze the tasks involved in aural study. Three books were examined. First, Adventures in English Literature (Priestley & Spear, 1963), a twelfth grade text; second, A Global History of Man (Stavrianos, Andrews, Blanksten, Hackett, Leppert, Murphy & Smith, 1962), a tenth through twelfth grade text; and, third, Modern Physical Science (Brooks, Tracy, & Tropp, 1962), a ninth and tenth grade text. These books had been professionally recorded and were available on discs as Talking Books. They were recorded at 16 2/3 revolutions per minute (rpm).

Prior to using the recorded editions of the texts, the authors examined the ink print editions to locate places where problems might be encountered. First, the formats of the texts were reviewed. Following this, the texts were examined in greater detail to identify material presented that might not be amenable to the recorded form. Once this was done the job analysis was undertaken.

Work sheets were set up on which the various tasks involved in the job of studying from recorded material were to be defined. These required the tasks be specified, the cue(s) initiating each be identified, and the physical responses to each of the cues be delineated. Additionally, notes were required to cover any and all relevant matters not directly covered by one of the specified categories.

Tasks of Studying from Recordings

Regardless of the medium used, certain preliminary arrangements must be made before a student is ready to start studying. First, he must consider his various assignments and schedule his time. In so doing he should consider the subject matters to be studied and his preferences for studying each. Depending on the subject matter, he might choose to study in sessions lasting several hours or in several sessions of 30 minutes each (Morris & Nolan, 1968; Nolan, 1966). It has been found that students generally prefer to study just one subject matter during any one study session when using aural material (Morris & Nolan, 1968). Once the student has scheduled his time he must find a place in which to study where he will be alone and where environmental noise will be at a minimum. It is desirable for a student to have a regular site for study so that his materials and equipment can be kept there in an organized fashion. If not, all necessary materials and equipment have to be assembled before studying is possible. Once this is done, the specific materials to be used in the immediate study session must be identified and set out for use. Intangibly, but importantly, a student should be in a frame of mind compatible with study to make the most of his study opportunity. He should be alert and able to concentrate on the topic at hand. He should want to learn and he should be able to integrate any new information which he encounters with that which he already knows. Once these tangible and intangible conditions are met, the student is ready for study.

A visually handicapped student studying from recorded materials sets up and operates all equipment used as he actively engages in using information or learning information presented in recorded form. He listens to the material and makes written or recorded notes of what he considers important. The student studies alone but may need occasional assistance from a sighted person to provide information not available or not readily accessible in the recorded edition.

The tasks of study that are enumerated here are specific to the study of text material recorded on discs. The tasks are outlined in Table 1. The playback equipment used was a Variable-speed Talking Book Reproducer. The tasks enumerated are specific to the model used but may be generalized to other models on which modifications appear. These modifications concern mechanical improvements and certain physical changes such as position of the earphone jack, position of the volume and tone control knobs, position of the speed regulator, and presence of hinge locks.

TABLE 1

Tasks of Studying from Recordings

Preliminary arrangements

Setup tasks

1. Identify material to study by determining the page(s) in the ink print edition on which it appears.
2. Find proper record and side.
3. Set up recorder.
4. Turn on recorder.
5. Adjust volume, tone, and turntable speed to personal preference.
6. Find place on proper side.

Operational tasks

7. Turn off recorder and remove pickup arm from disc.
8. Turn off recorder leaving pickup arm in place.
9. Turn on recorder with pickup arm left in place.
10. Pause.
11. Move needle in fine gradients.
12. Change discs.
13. Replay a short section.
14. Speed up play.
15. Slow down play.
16. Skip.
17. Scan.

Study tasks

18. Find a topic in a recorded table of contents.
19. Find a topic in a recorded index.
20. Search for specific information in text.
21. Take notes.
22. Copy verbatim a recorded selection.
23. Learn new words.
24. Interpret recorded description of information presented graphically.

Setup Tasks

1. Identify material to study by determining the page(s) in the ink print edition on which it appears. Find pages by (a) noting them at the time the assignment is given, (b) reference to the table of contents*, (c) reference to the index*, (d) reference to personal notes, or (e) asking a sighted person to locate them in an ink print edition of the book.

   * If the table of contents and/or index is recorded, 3, 4, and 5 will have to precede 1 and 2. See 18 and 19 for specific instructions.

Page numbers are the key to all searching. Because of this there is a need for both the table of contents and the indices accompanying a book to be in written form as this form provides for more efficient scanning than does the recorded form. Additionally, page numbers and record side numbers should be related. This information could be included with the table of contents, given in a written key, written on the individual record cases, or written on the labels of the records themselves.

The format of the three Talking Books examined was not consistent. In two, the table of contents provided information relating pages and sides segmented as in the ink print edition. This arrangement provided enough information to locate specific selections, etc. but was time consuming to use, particularly if the user had no advance information as to where in the book the sought material might occur. When pages are known, the table of contents can be scanned for information relating side and page. This, also, is a time consuming chore. In the third book examined the table of contents was abridged and provided only gross groupings of pages and sides. At the start of each side the contents, with page numbers, were given for everything occurring on that side. This arrangement was extremely inefficient for the user as it required him to make his initial estimate from gross information, then play the start of that side, then correct from the information thus acquired, etc. until eventually the side containing the desired pages is located.

When information is presented in this manner it is best for the user to go through the entire recorded book prior to using it playing the first of each side and noting the page range contained on each side. Then, for specific assignments, after learning the pages needed, he can refer back to his own notes to learn which side will contain the desired page.

A mimeographed table of contents relating sides and pages was included with this third book. As it was printed in elite type it precluded use by the vast majority of legally blind persons. Practically

speaking, this means that a person with vision would have to read the table of contents provided and relay needed information to the user of the recorded book. As stated, a written table of contents relating pages and sides is needed for use with recorded textbooks; however, it should be in braille and large type.

Indices were omitted from the recorded edition of all three of the books examined. These, too, are essential if a student is to have maximum access to the content of a book. As with the table of contents, an index needs to be written if it is to provide for efficient use; however, it too should be written in a form the user can read.

2. Find proper record and side. Locate probable disc and side from information contained on the disc labels [side number appears in braille on one side of each disc and in ink print (not large type) on the other side]. Estimate approximate side when information as to side is not specific and play the beginning where information is given as to the page with which it commences, e.g. page 41 continued. Correct as necessary until the appropriate side is found.

If a student is continuing with something from a previous study session, the task of finding the proper side is minimized if he has noted where he left off, e.g. side 11, page 99, middle of disc, at the time he terminated the previous study session. Natural stopping points, such as at the end of a side, may be utilized or, when possible, the record can be left on the recorder with the needle in place.

Another useful gimmick is for the user to make a note of the place whenever he comes across something to which he may wish to refer.

Persons not reading braille or regular ink print may have to play the first of each side to get a book in sequential order or ask help from someone who can read the labels. Once in order, sides can be located from position within set.

3. Set up recorder. Orient the recorder so the case latches face the user. Unlatch the cover and open the case. Decide whether the speaker, which is located on the inside of the cover, or the earphones are to be used. Insert the plug of the chosen output into the jack at the right rear of the motor board. Unwind the cord from the two cord storage brackets at the rear of the motor board and plug the cord into an electrical outlet, 110-120 volts, 60 cycles, AC current.

When the recorder is not in use and is not going to be moved it may be left set up but should have the cover set over it so that it will be protected from dust. The cover will not latch unless the cord is stored inside the machine.

If the speaker is selected for use, it may be left hinged to the bottom part of the case or removed and placed behind it or slightly to the side. The cord attaching the speaker to the recorder is quite short, 18 inches, which severely limits positions possible. If left hinged to the bottom of the case the speaker must be propped against something. Hinge locks and a longer cord for the speaker would contribute to convenience of use.

4. Turn on recorder. Place a record, the one to be used if known, on the turntable. Locate the tone and volume control knobs at the right front of the motor board and turn each a quarter turn clockwise. Locate the speed regulator along the left side of the motor board, toward the rear, and move the lever back to the first mark for 8 1/3 rpm records, to the second mark for 16 2/3 rpm records, and to the third mark for 33 1/3 rpm records. Wait 15 seconds while the turntable attains its set speed. Swing the pickup arm to the left and set the needle down gently. Wait until the turntable regains set speed before adjusting.

5. Adjust volume, tone, and turntable speed to personal preference. Turn the right hand knob at the right front of the motor board clockwise to increase the volume and counterclockwise to decrease the volume. Turn the knob to its left, the tone control, clockwise to shift the tone to higher frequencies (treble) and counterclockwise to lower the frequency (bass). Move the speed regulator lever back to increase turntable speed and forward to decrease turntable speed.

All control knobs and levers operate on a continuum enabling users to adjust the Talking Book Reproducer to suit their personal tastes along the dimensions of volume, tone, and speed. As the latter varies from the speed at which the record was made, distortion is introduced.

6. Find place on proper side. Determine the range of pages on a side from information given in the table of contents or by playing the first of each side where it tells the initial page on the side. Estimate the distance into the disc where the desired page might appear. Listen until a page number is read. Correct by moving the needle either towards the outside edge for a lower page number or further in toward the center for a higher page number. Listen and correct through split halving procedure until the sought place is found.

As mentioned under 2, if a student is continuing with something from a previous study session a note indicating the side and the approximate position within the disc where study should commence will facilitate the place finding process. Here, a detent positioning device for the pickup arm would be useful. Also, if records could be marked, temporarily, as with a dot of wax, it would be helpful.

Several difficulties were encountered in the searching process. One was that it was extremely difficult to move the pickup arm in fine gradients, yet, precious minutes are wasted if the user has to wait while an eighth of an inch of grooves is played. With the Variable-speed Talking Book Reproducer the turntable speed can be increased but with the resulting distortion recognition of page numbers becomes arduous. Another difficulty was in not damaging the record during the search process. When moving the pickup arm the record is apt to be scratched. Solutions for these problems revolve around a system for indexing material recorded on discs and in utilization of pickup arms which produce a minimal tracking-weight.

Operational Tasks

7. Turn off recorder and remove pickup arm from disc. Lift the pick-up arm and swing it to the right. Set it on its holder. Locate the speed regulator lever and pull it as far forward as it will move to its off position. Locate the tone and volume control knobs and turn each counterclockwise until a click is heard and they will turn no further. Remove disc and replace in its envelope.

8. Turn off recorder leaving pickup arm in place. Locate the speed regulator lever and pull it as far forward as it will move to its off position. Stop turntable simultaneously by placing a finger on the rim of the disc thus preventing glide. Locate the tone and volume control knobs and turn each counterclockwise until a click is heard indicating they are in their off positions.

9. Turn on recorder with pickup arm left in place. Locate the tone and volume control knobs and turn each a quarter turn clockwise. Wait about 15 seconds for the recorder to warm up. Place one finger on the outer part of the record's label and turn the disc one or more revolutions counterclockwise. Push speed regulator lever to desired setting and start the turntable rapidly by flipping the rim of the record in a clockwise direction. Adjust all controls as described in 5.

10. Pause. TO STOP: Pull the speed regulator lever to its off position while simultaneously stopping the disc by placing a finger on its rim. TO START: Place one finger on the outer part of the record's label and turn the disc one or more revolutions counterclockwise. Push speed regulator lever to desired setting and start the turntable rapidly by flipping the rim of the record in a clockwise direction. Adjust speed.

In relation to 8, 9, and 10, there is a problem with glide when the turntable is stopping and build up time when it is starting. For this reason it is necessary to manually assist in stopping and

starting the turntable. When the speed regulator lever is in the off position the turntable will move counterclockwise. By turning it back one or more revolutions prior to restarting time is provided in which the recorder can attain its set speed without the user missing anything he has not previously heard.

It would be highly desirable to have the turntable on the recorder stop and start, at the set speed, instantaneously as does the tape mechanism on a tape recorder. Additionally, a foot or knee controlled mechanism for pausing would be useful as it would leave a users hands free for other purposes such as note-taking.

11. Move needle in fine gradients. Rest the outer edge of the right little finger on the record's arm holder. Place the tip of the right thumb on the playing end of the pickup arm. Pushing lightly with thumb, move needle by raising the arm slightly and moving horizontally to the desired position. Replace the needle on the record gently.

The grooves on records are so delicate that any time the pickup arm is moved by hand there is a danger the disc will be damaged. Supporting the hand on the arm holder of the recorder enables better control and steadiness in making minute manipulations as does exerting pressure with the thumb.

12. Change discs. Remove pickup arm by raising it, swinging it to the right, and setting it on the arm holder. Holding the record by its edge, lift it from the turntable, which may be stationary or moving, and turn it over if the other side is to be played. If no longer needed, replace the record in its envelope and put it away in its proper place. Locate the next record to be used if not already in hand. Holding it by its edge, set it on the turntable with the appropriate side up. Locating the center hole with a finger may help in positioning it. Raise the pickup arm from its holder, swing it to the right, and set the needle down gently on the record at the predetermined place.

13. Replay a short section. Stop the turntable by pulling the speed regulator lever to its off position. Move the pickup arm by hand away from the center for the estimated distance as described in 11 or place a finger on the outer part of the record's label and turn the disc counterclockwise for the estimated distance. Restart as described in 9. Correct as necessary.

When the part to be replayed is very short, it is more efficient to turn the record back by hand than to attempt to move the pickup arm and its attached needle a few grooves. For a longer replay it may be more efficient to move the pickup arm. It would be extremely useful if the turntable would reverse so something could be replayed easily without risking damaging the record.

14. Speed up play. Move the speed regulator lever forward gradually until the desired speed is reached.

There are several reasons a user might want to play a record at a speed greater than that at which it was made to be played. Probably the primary reason for increasing the speed of playback is to reduce time spent listening. Other uses would include scanning material and in place finding. Intelligibility is negatively related to the amount a record is sped up but remains reasonably good when the rate of increase is moderate.

15. Slow down play. Pull the speed regulator lever back gradually until the desired speed is reached.

A person might want to reduce the speed of something to which he was listening if it were of a complex nature or if it were something he wished to thoroughly assimilate. Another reason for reducing playing speed would be so that brief notes could be made while listening.

16. Skip. Estimate the distance on the disc which is to be skipped using whatever information that is available, e.g. table of contents. Move the pickup arm inward on the disc the estimated distance using the technique described in 11. Set the needle down on the disc gently; listen; correct as necessary.

17. Scan. Determine the purpose of scanning and determine the type of scanning required to accomplish it. Locate the disc(s) to be scanned (1, 2). Use place finding techniques (6) to locate specific pieces of information. Sample material systematically or selectively by skipping (16) and listening to brief sections of the material at each resulting interval to gain an overall impression or general review of the content.

Study Tasks

18. Find a topic in a recorded table of contents. Locate the first side of the recorded book from information contained on the labels of the discs (2). Scan (17) until the table of contents is found. Listen consecutively or selectively (17) until the table of contents is found. Note page number(s) and side(s), if given.

If the table of contents of each side is given at the start of each side, as described in one case cited in 1, the user will have to listen to the start of each disc to hear the complete table of contents. If any other means can be used to get the needed information it is recommended that it be used as this is a tedious chore.

19. Find a topic in a recorded index. Locate the discs containing the index (1, 2). Estimate the position within the index where the topic would occur alphabetically (indices are always arranged alphabetically). Sample content. Correct as necessary. Note page(s) of desired information.

The format of indices makes them difficult to use when recorded. For this reason they are frequently omitted. For the sake of efficiency, even if a recorded index is available, it is desirable to obtain the needed information from a sighted person having access to the ink print index. A written index is needed in both braille and large type if a visually handicapped student is to be able to study independently.

20. Search for specific information in text. See 1, 2, and 6 which will require the techniques described in 16 and 17. Also, it is possible that use of the table of contents and the index (18 and 19) will be necessary.

21. Take notes. Replay (13), if necessary. Pause (10). Write or record notes. Replay (13) to verify, if necessary.

Note-taking is a critical factor in studying from recorded material. Work space allotted for study must be sufficient to provide for the equipment required which may be a braillewriter, slate and stylus, typewriter, pencil or pen, tape recorder, or any combination of these. Two types of notes are generally required. First, those of a temporary nature such as the place where study should commence at the next study session. Second, those which are to be a permanent record. A student may want to record his notes as he studies and later transcribe them or vice versa. The final form should be that which is easiest for the student to use. Essential for this is a plan of overall organization.

Because of the time required in finding things on records it is necessary to take more extensive notes when studying from aural material than when studying from written material. A written study guide to accompany a recorded text would greatly diminish the notes a student would need to make.

22. Copy verbatim a recorded selection. Listen to the entire selection to be copied. Stop the recorder and find the place where the selection begins using the method described in 13. Listen to a short section. Pause (10). Write out the section just heard. Replay (13), if necessary. Listen to the following part. Pause (10), etc. until the entire selection to be copied is completed. Verify written copy by replaying (13) the entire selection. Proofread the written copy as the selection is replayed. Correct as necessary.

There are a variety of things that might need to be copied verbatim. These include things to be memorized, as a poem or a part in

a play, quiz questions, verbal information from which graphics are to be reconstructed, bibliographic references, exact quotations, etc. Format and punctuation are problems as it is not possible to know just how these appear in the original written text without asking help from a sighted person with access to the print text.

23. Learn new words. Pause (10) when a new word is encountered. Replay (13), if necessary. Decide whether to make a note (21) of the word or not. Seek definition for term if not apparent from content either immediately or later. Use the glossary, if one is available, or other source at the time the word is encountered if it is critical to understanding the text material. Note (21) the word and check the definition at a later time if the meaning is not of immediate importance. Search a glossary as an index (19).

Searching a glossary requires changing discs and the inherent place finding procedures accompanying it. Because of this, it is more convenient to wait until a stopping point is reached in the material being studied so the disc being studied will not have to be replaced and the place found again.

New words fall into three general categories: unknown English words, proper names, and foreign language words or those in a dialect such as a Scotch brogue. Frequently new words are spelled when first encountered. If not, spelling and/or definitions may be found in dictionaries, the books's glossary, word lists which may accompany the unit or chapter, footnotes, or study guides. Spelling and information about persons, places, or things named may be found in glossaries, footnotes, or study guides. Other sources include encyclopedias or possibly dictionaries. Foreign language or nonregular English words may be given in glossaries, footnotes, or study guides; however, it may be necessary to refer to foreign language dictionaries for information on these. In all cases, unknown words can be noted and the teacher queried about them at another time.

Written word lists and/or glossaries would help a student cope with new words.

24. Interpret recorded description of information presented graphically. Listen to entire description. Pause (10). Determine the value of the graphic. Decide whether to make notes (21) of the information presented, to copy it (22), or, having heard it, that no further action is required. Replay (13) any or all, if necessary.

Recorded tables and graphics are dull, time consuming to hear, and are apt to be lacking in meaning if not read in a highly structured context. They are generally easier to interpret if written. Some must be reconstructed from the information read in order to be usable which presents a tedious chore. If information presented in a graphic is

thoroughly covered in the text, it is possible to skip the graphic. However, before omitting a graphic it must be carefully evaluated as graphics frequently contain more information than is discussed in the text material.

Implications for Aural Study System Development

Information acquired through the task analyses has provided guidelines for the development of hardware and software to be used with aural study. A summary of these findings as related to their applications follows.

Specifications for a disc recorder to be used for study purposes would be that it be both small and light weight so that it might be portable. Operational features should include instantaneous stop-start, forward and backward movement, a variable speed capacity, remote controls for stopping and starting and forward-backward movement, a detent for pickup arm positioning, incorporation of a new type of pick-up or tone arm too light in weight to damage the grooves of a record, and a multitrack capacity to provide for an indexing capability.

Certain difficulties encountered in using the Variable-speed Talking Book Reproducer, even as a recreational device, pointed out operational weaknesses. These were related to the variable speed mechanism and have subsequently been corrected.

Suggestions concerning the improvement of current recording methods primarily centered around the need for an indexing system to be used with recorded materials. Closely related to this were observations concerning tables of contents, information presented on disc labels, and, of paramount importance, the need for page numbers and disc sides to be related as discussed under 1.

Two types of indexing systems have evolved since recognition of the need for them. They are not mutually exclusive. One utilizes the two tracks within a groove employed by stereophonic recording methods. On one track the content material is recorded at a slow rate. On the other track indexing material, calibrated in position with the content track, is recorded at a rapid rate making possible rapid scanning. The tracks can be switched at will. The second indexing technique employees use of narrow bands on a disc to separate major subcomponents of the recorded book. These can be detected by a photoelectric cell as the tone arm moves across the disc and are indicated by audible beeps.

As the task analyses were conducted it became apparent that certain parts of textbooks would be more useful if written. Essentially, these were the sections to which a user might repeatedly refer such as

the table of contents, the index, the glossary, references, and study questions along with the most graphic material. Additionally, it appeared that a written outline of headings would be of great value as it would provide a frame of reference and serve as a source for supplemental information that could be used in the place finding process. Written lists of new words, proper names, and other pertinent vocabulary were also recognized to be of value as these would provide spelling information. If such material were presented in a written supplement it would alleviate the note-taking burden inherent to aural study. The combined use of recorded material accompanied by written supplements would combine the most useful features of both modes of study. It would represent a new concept in education for the visually handicapped.

Should a written supplement be provided to accompany a recorded book, a great many editorial decisions would be required in determining what should be written, what should be recorded, and what should be presented in both modes. Editorial duties would include indicating where page breaks should be announced, marking words to be spelled by the reader, making lists of words to be included in supplemental spelling lists (particularly important in the absence of a glossary), editing picture captions and indicating if and where they should be inserted in the text, identifying footnotes as such and indicating where they should be read, marking quotations so they will be clearly identifiable as quotations when read, indicating reference material, and thoroughly referencing all material appearing in the supplements as it occurs in the text. Resequencing material might also be involved in the editing of it.

The recorded textbooks reviewed in this study did not appear to have been systematically edited. Careful review of a book is needed before anything is edited out. For instance, frequently picture captions were omitted. In some instances information given in these captions was needed in order to answer the study questions. Another extremely questionable practice, as previously noted, was the editorial decision to leave out the indices. This omission greatly increases the difficulty of independent study and diminishes the usefulness of a book.

Certain format changes appear to have merit. One of these would be to shift study questions to precede the section to which they pertain. This practice would both provide a frame of reference and alert the user to the information presented with which to answer them.

Several suggestions for readers evolved from the analyses. These dovetail with some of the editorial duties cited. Concerning pictures: they should not be described and only mentioned if an entire page is devoted to them. Meaningful picture captions should be inserted in the text at the appropriate places as is customarily done. Concerning maps, graphs, tables, and charts: these should be mentioned and reference to the appropriate supplements made, if provided. They should not be

read if supplements are provided; however, if not, they will have to be read with maps being described and the information presented in graphs, tables, and charts read in as structured a context as possible. Concerning footnotes: these should be identified as such and read immediately following that to which they refer. Concerning quotations: these should be so identified and reference made to the supplement providing the reference, if provided; or, if not, the reference itself read immediately following the quotation. Concerning headings: these should be read with emphasis so they will stand out from the text material. A brief pause should follow each. Concerning spelling: all new words, foreign words, and uncommon proper names should be spelled the first time they appear in the text.

One of the goals of the task analyses reported here was to obtain information to be used in writing an instructional manual, specific to the blind, concerning study techniques best suited to aural study. Need for such a manual was recognized by Nolan (1966) and Morris and Nolan (1968) when they discovered that groups of visually handicapped students with whom they were working had received no training in how to use recorded materials although they customarily studied from such materials. It became evident that the reason they had received no training was that there were no materials available with which to train them.

Information acquired through the task analyses was necessary before an instructional manual could be written as it delimits the tasks involved and describes materials and equipment involved. When integrated with general knowledge from the field of learning, information about aural learning, and what is known of aural learning by the blind, a specific and useful manual should evolve.

The problems identified in use of recorded texts do not appear to be insurmountable, particularly in terms of the materials and equipment to be mass produced. The suggestions resulting from the task analyses indicate need for a new study type machine for playing discs, the services of an editor, production of supplemental material in both braille and large type, and stereophonically cut discs containing indexing information.

Volunteers recording single copies do not have the facilities available to them to provide as complete a system as that possible on a commercial basis. Even so, if they will keep in mind the critical issue of relating page numbers to tape sides and tracks they will greatly increase the ease with which their tapes can be used. Open reel tape recorders, as the adapted Sony model marketed by APH, incorporate many of the features specified for a study player. The Sony features instantaneous stop-start, fast forward and backward capability, variable speed, and a mechanical device for inserting sound signals on the tape that can be used for indexing purposes, as for indicating pages. Cassette

models, though delightfully portable, are not as useful for study purposes. Unfortunately, they have very slow fast forward and rewind operations, no remote control options, no variable speed capability, and no indexing devices. Additionally, there are certain problems with the cassettes themselves, such as breakage of the tape and irregular rewinding. Neither of these are repairable.

Two major problems are common to tapes of both types. First, in the production of them fades occur. The only way these can be discovered is by listening to the entire tape. The second problem occurs in the use of them. It is that gross search of the contents of a tape is a much greater task, in both time and effort required, than with a disc. To sample the contents of a disc the stylus only has to be set down on the disc and left to play briefly at a few places. To sample the contents of a tape the whole tape must be run through and then rewound.

From the task analyses it became quite evident that certain parts of texts are not amenable to aural presentation. These are those parts used for reference (table of contents, bibliography, glossary, index) and graphics (maps, tables, charts, graphs). Additionally, certain subject matters, as mathematics, appear to be inappropriate for aural study (Morris & Nolan, 1968; Nolan, 1966).

Although there are certain problems in the use of recorded text material, there are also many decided advantages. For mass produced recordings cost is much lower and availability faster than for braille or large type editions. For single copy editions, as required by more advanced students and those working on individual projects, recordings or reader services are usually the only means for rapid access to text material.

The specifications for the hardware and software for aural study, as identified in the task analyses described here, should make the job of studying from recorded materials considerably easier and by alleviating the number of notes required, greatly add to the efficiency of aural study.

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Aural Study Systems for the Visually Handicapped

Recorded Textbook Formats and Aural Study Methods

A Summary of User Opinions

June E. Morris and Carson Y. Nolan

American Printing House for the Blind, Inc.

Louisville, Kentucky

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The research reported herein was performed pursuant to a grant with the Bureau of Education for the Handicapped, U. S. Office of Education, Department of Health, Education, and Welfare. Contractors undertaking such projects under government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official position of the Bureau of Education for the Handicapped.

Department of Health, Education, and Welfare

U. S. Office of Education
Bureau of Education for the Handicapped

Research conducted by the Department of Educational Research at the American Printing House for the Blind (APH) has shown it to be more efficient for visually handicapped students to learn some types of material when presented by aural means than when presented in written form. This is caused by the relative disparity between the rates for recorded speech and those for reading both braille and large type (Nolan, 1966, Ch. 3). Consequently, it seemed desirable to develop a study system taking advantage of the greater efficiency of recordings.

In order to develop a total system for study specific to recorded material, a long term research project was initiated. The part of that project being reported here had two purposes: (1) to analyze textbook content to determine the format which would provide for the most efficient use of recorded material and (2) to explore study techniques currently in use by sophisticated students who use aural material for study purposes.

Method

Subjects

Nineteen visually handicapped students at the University of Texas participated in this research. Eighteen participated in each of two phases of the project. The students were, in all respects, a diverse group ranging from freshmen to graduate students and representing many fields of study. Some students could read braille, some large type, and some regular ink print (with or without magnifying aids). One could read neither braille nor print. Several had only recently become visually handicapped. The one thing they had in common was that all were users of auditory materials through reader services and/or recordings.

Material

Two types of materials were developed to provide information relating to the two purposes of the study; namely, textbook format and study techniques.

Format is defined by Webster (1963) as the shape, size, and general makeup of a publication. In order to determine these component parts of textbooks, three were examined. These were a history book entitled A global history of man (Stavrianos, Andrews, Blacksten, Hackett, Leppert, Murphy, & Smith, 1962), a science book entitled Modern physical science (Brooks, Tracy, & Tropp, 1962), and a literature book entitled Adventures in English literature (Priestley & Spear, 1963). From these

books 14 different parts common to textbooks were identified, though not all 14 parts occurred in all textbooks. Lists of these parts, along with a defining statement for each, were produced in both braille and large type. Instructions accompanying these lists directed the user to consider each part carefully, to decide whether each would be more useful in written or recorded form, and to write out his preference for each along with his reasons.

An interview form, based largely on one used in a pilot study conducted in 1965 (Nolan, 1966), was developed to investigate study techniques. It contained 19 questions and was designed to be used as an open-end instrument.

Procedure

Subjects were initially contacted by university personnel who briefly described the project to them. Those who were interested in participating were instructed to attend one of several meetings being held for briefing purposes. At these meetings the potential subjects were given a more thorough description of the research project and those interested in taking part were given a list of textbook parts. At this time they were instructed to write out their opinions as to the form in which each textbook part would be most useful to them and told to turn their reports in at a university office within 12 or 13 days. Before leaving the meetings, participating students were scheduled for individual interviews to be conducted approximately two weeks later.

Each subject who agreed to participate was told he would be paid a sum of $10.00 for his time and effort. By "hiring" the subjects it was felt they would be motivated to take the task seriously and follow through with it.

The reports were reviewed and, at the time of the individual interviews, any vague point clarified. The interviews; however, were primarily directed toward learning the study techniques individual students had evolved for use with material presented aurally.

In total, answers to 33 questions (14 on format and 19 on study habits) were sought. Responses of students were analyzed in order to define, where possible, a composite opinion.

Textbook Format

1. Preface and/or Foreword

Eighty-nine percent of the students interviewed stated their preference for recorded prefaces and/or forewords. Their reasoning was that the content of such is usually of the background variety and is not likely to contain details to be learned. There was a division of opinion as to the value of this material, some feeling it to be essential and others saying it was of little importance or use. Eleven percent said they would prefer to have this material written.

2. Acknowledgements

The acknowledgements section of books was considered of little value and/or interest by the interviewees. Of them, 15 (83%) said they would prefer to have it in recorded form, while one wanted it written, one wanted it in both written and recorded forms, and one suggested it be omitted.

3. Table of Contents

The table of contents is a section to which referral is frequent. Because of this, the majority (83%) of students interviewed stated they wanted it in written form. Another 6% wanted it in both written and recorded form while the remaining 11% preferred to have it recorded. It was felt by the majority, that a written table of contents is more practical as it provides for more efficient use. In written form, scanning is possible, the time consuming process of changing tapes and discs is eliminated, and the spelling of some proper nouns is apparent. There was a strong feeling that more precise information should be given as to location of the itemized sections, i.e. page X, reel no. 5, side 2, track 3, approx. 300 ft.

4. Introduction

It was felt by 89% of the students that introductions should be recorded as they contain no hard core material to which referral is necessary. Eleven percent stated a preference for this part to be in written form. It was apparent that the introduction to a book is a part that is sometimes not used by the reader.

5. Text

Eighty-three percent of the interviewees said they preferred text material in recorded form while 17% said that the best medium depended on the type of text material involved. Reasons given for preferring the recorded form were that it is the more rapid way to cover material and that it reduces physical fatigue. One student pointed out that, "Lengthy ink print or braille form requires more concentration on mechanical aspects of study and places less stress and emphasis on learning and comprehension of content."

A number of suggestions were made as to how material should be recorded. Several were: (1) page numbers should be read at the beginning of each new page, (2) text material should be read at a rapid rate, and (3) all new words and new forms of words (as in a foreign language) should be spelled slowly and carefully on first encounter.

Other suggestions were made regarding supplementary written material needed for use with recorded material. Several of these were: (1) a list of names and terms of doubtful spelling, (2) any documented material, and (3) summaries for quick review.

Headings. Headings should be clearly identified and emphasized. It was felt that this would be extremely helpful as many students like to look over the headings prior to reading a chapter.

It was felt that headings should be clearly identified and emphasized. Several students suggested that a recorded or written table of headings be available for use. If recorded, it should be placed at the beginning of a chapter. Other suggestions for making headings stand out were that they be read emphatically followed by an elongated pause or that they be identified by the reader saying, "major heading," "subheading," etc.

Quotation marks. Students need to be aware of the content of exact quotations; therefore, readers should identify these by saying, "quote," and "close quote," at the appropriate places.

Non-literary symbols. A braille student using recorded materials needs to learn the braille code and format for mathematics, science, and foreign languages just as a sighted student does. Auxiliary written material, braille and print, is needed to accompany any of these subjects when first presented in recorded form.

New words. As mentioned previously, certain words should be spelled when first encountered in recorded form. Proper names and new words that are difficult and cannot be sounded out should be spelled as they occur. An editing problem for the recording of books is created by the necessity of determining which words are new words.

6. Graphics

The interviewees were unanimous in feeling that recorded graphics were usually inadequate. Sixty-one percent thought they should be presented in written form, 28% thought the best way to present them would be in both written and recorded forms, and the remaining 11% said the best way for a graphic to be presented was determined by the nature of the graphic. Several students pointed out the importance of having written graphics clearly labeled. It was also suggested that every graphic in a textbook be included and that clear indications to which graphic referred should be made. Opinion was expressed that graphs, tables, and charts should definitely be written, one reason given being that these graphics usually contain important information and being in written form facilitates review and reference. Some felt that pictures, sketches, drawings, and cartoons might be verbally described, though comment was made that word explanations frequently are not meaningful to congenitally blind people and that if a drawing could be enlarged enough for use by those with some vision, with or without low vision aids, this would be the most desirable medium of presentation. It was noted that students are sometimes quizzed on graphics and information contained in their captions.

7. Footnotes

A division of opinion was found to exist concerning the placement of footnotes. Some students felt all should appear immediately following that to which they refer while others felt only those giving additional information about the topic at hand should be included with the text material and that those of a reference type should be given at the end of the text material. Several students noted it was disconcerting to have anything interrupt the text and that such interruptions were apt to make them lose their train of thought.

Seventy-two percent of the interviewed students stated a preference for footnotes in recorded form, 11% for them to be in written form, 11% said they would like the general type to be recorded and the reference type to be written, and 6% suggested that footnotes be omitted altogether.

8. Study Questions

The majority (56%) of interviewees stated a preference for study questions to be written. Reasons given primarily emphasized that written questions were more efficient to use as they could be referred to while listening to the text material and; therefore, saved the user time and effort in that he wouldn't have to (1) search for the question, (2) search for the answer in the text, (3) search for the next question, etc.

Twenty-eight percent of the students thought study questions should be in recorded form; however, it was suggested they be placed preceding that to which they were pertinent and that they be read slowly and clearly with a pause between each.

The balance of the students felt that study questions should be both recorded and written or that the medium should be determined by the subject matter with subjects like mathematics and foreign languages written and subjects with more general questions, in English, recorded.

9. Suggested Activities Sections

Two thirds of the interviewed students said they preferred the recorded form for suggested activities as opposed to one third who preferred the section in written form. Many students noted that, at the college level, this section is rarely used. The reasons given by those wishing the section in recorded form were so that the section could be scanned rapidly and that the activities did not need to be written as they were generally broad suggestions not containing specific detail. It was suggested this section be read slowly and clearly with a pause between the activities suggested. Those wanting the section in written form felt this medium more desirable because it provides for easier reference.

10. Bibliography and/or References

Interviewees were split in their preferences for the best medium of presentation for bibliographic material with 50% preferring it written, 39% preferring it recorded, and 11% wanting it in both forms. Those wanting it written cited easier access as a reason and noted that this medium provides spelling, format, and other details all of which make such material difficult to copy. Those desiring the recorded medium suggested that all authors' names be spelled. They pointed out that coverage is more rapid with recorded material and that notes could be made of essential references. Those students desiring bibliographic material in both forms were thinking in terms of immediate use and later reference.

11. Appendices

Fifty percent of interviewees stated a preference for recorded appendices, 33% for written, and 17% for mixed saying ones containing straight reading could be recorded but those containing important tables or graphics should be written. Those responding in favor of recorded appendices mentioned this medium enabled more rapid reading. Students preferring the written form usually made reference to the need to periodically refer to tables, charts, maps, reference lists, etc. Obviously, appendices are often either skipped or not read in their entirety.

12. Glossary

One student reported that recorded glossaries would be acceptable for any subject other than a foreign language, if the words were spelled; another stated the opinion that for foreign languages glossaries needed to be in both recorded and written forms; all others (89%) said they wanted glossaries to be in written form. Various reasons for this preference were given, some of which are enumerated here. Written glossaries: (1) are more convenient and efficient to use, (2) do not require the use of two recorders; one for the text material, the other for the glossary, (3) are easier to scan (glossaries never being read in their entirety), (4) provide a ready reference, and (5) prevent discs from being scratched during searching.

One suggestion made was that words in a glossary be numbered and that their numbers be inserted following the words wherever they occur in the text. Such a procedure would alert the user to the fact that the word's definition was available and might help locate the word in the glossary.

13. Index

The index is an important part of a book which is frequently skipped in recorded versions. This is probably done because of the difficulties inherent in using a recorded index one of which was well expressed by a student saying, "An index is virtually useless in a recording, for it is very difficult to find individual words or terms of an index within a recorded text."

Eighty-nine percent of the students interviewed wanted written indices with their recorded textbooks. The other 11% said they preferred them to be recorded. Whether written or recorded, the students felt it would be desirable to have more precise information as to location than just page number.

Students favoring written indices mentioned that this form was faster and easier to scan, did not necessitate the use of two recorders nor require the changing of discs or tapes with its intrinsic place finding routine.

14. Notes

This is a broad category under which a variety of types of information is contained, such as, summarizing information, additional references, comments, auxilliary information, etc. The best medium for presentation can be expected to be somewhat dependent on the type of notes involved. In general, reasons stated previously favoring recorded or written material also apply for notes.

A number of students said that notes should be placed in close proximity to that to which pertinent. However, not all felt this way. Fifty-six percent of the interviewees stated a preference for notes to be recorded, 17% for them to be written, and 22% thought the medium should be determined by the type, placement, or length of note. (Reference type, those containing formulas or equations, brief notes, and those at the end of a text [not chapter]--to be written.) One student was undecided as to the best medium. It was noted that written summaries provide excellent study devices.

Study Techniques Used with Aural Material

15. Experience with Recordings

Eight of the 18 students interviewed had used recordings for less than five years, seven for five to 10 years, and three for 10 or more years.

16. Study Instruction

Most students had worked out individual techniques for study from recorded material on their own. None had received any formal instruction on how to use recordings. One student commented that there is a manual available from Recording for the Blind (RFB) that suggests a few techniques.

17. Means of Receiving Aural Material

The college students interviewed were all either using or had been using reader services. Many of the students had their readers recording material for them. Sometimes this was done concurrently as they listened and sometimes it was done at a different time for their later use. All such material was recorded on tape as were any classroom lectures that students choose to record.

RFB was the primary source for other recorded material with an occasional Talking Book being used. Both of these, in the past, have been recorded on discs though recently RFB started recording all new titles on tape. Undoubtedly, the proportion of discs to tapes used by students will reflect this change in policy.

Student use of disc and tape materials ranged from one claiming to use 95% discs to one claiming to use 100% tapes. The matter is confounded by some students having their readers tape material for them and others using their readers only directly. Due to this and the finding that many students were unable to estimate the proportion of discs to tapes they used, no approximate proportion of use can be reported.

18. Equipment Used

All students owned either a disc player, a tape recorder, or both; the Talking Book Reproducer being the most common disc player used. Forty-four percent said they owned a second tape recorder, these usually being of the small transitorized variety for easy portability. Fifty-six percent reported using earphones and 17% said they used auxilliary loud speakers at least part of the time.

Various equipment for writing was reported (39% using braille-writers, 17% typewriters, 17% slates and styli, and 33% paper and pencils). Some students reported more than one way of writing and others reported none. The percentages shown here are probably lower than actual.

19. Earphone Use

Forty-four percent of the interviewees stated they did not currently use earphones while 17% reported using them either all of the time or nearly all of the time. The other 39% reported use somewhere along the continuum between.

20. Advantages and Disadvantages of Earphone Use

Only 15 students responded to this query. Of these, the advantage of earphone use mentioned most frequently, by 80%, was not bothering others enabling study with others around, in the library, or late at night. The second most frequently cited advantage (47%) was that they cut down on outside distractions. One student mentioned that it is easier to hear a recording of poor quality through earphones than through a loud speaker. Another mentioned being less likely to go to sleep using them as earphones restrict ones position preventing study while lying down.

Twenty-seven percent of the students responding mentioned discomfort as a disadvantage of earphone use with another student commenting that large earphones are more comfortable than small ones. Fifteen percent felt that not being able to move about was definitely a disadvantage. Other disadvantages mentioned were that: (1) use makes it difficult to hear people entering the room or the phone ringing, (2) the user is more likely to go to sleep, (3) it is more difficult to hear through earphones, if outside noises, (4) the user can't lie on his side to study, and (5) RFB recordings are harder to understand, through earphones.

21. Distractions

When asked if easily distracted while studying from recordings, about half the students interviewed said they were and about half said they were not. Distractions cited fell into three general categories;

environmental conditions, quality of the recording, and user characteristics. All vary from time to time and interrelate. A user who generally is not easily distractable may, on some occasions and under certain circumstances, be so.

Under environmental conditions things mentioned as distracting were people, telephones, TV, music, doors opening and shutting, traffic, other recorded material within hearing, public address system announcements, all noises, room temperature, etc.

Features of the recording itself found distracting were either related to poor technical quality or annoying reader characteristics.

The third category of distractions are ones that are internal to the user and relate to his ability to concentrate.

22. The Problem of Drowsiness

Previous research (Nolan, 1966) done with blind high school students who were accustomed to studying from recorded materials, reported that two-thirds of the students sometimes found drowsiness a problem when using recordings. In the current research, with college level students as subjects, 50% said it was sometimes a problem and another 22% implied that it was.

Numerous suggestions were offered for combating drowsiness such as moving around, drinking coffee, taking short breaks, and not lying down. One student commented drowsiness was no problem if taking notes. Others suggested changing positions every 30 minutes, taking No Doz, using earphones, or doing some peripheral activity such as shining shoes or folding clothes. Others suggested not studying unless feeling able or if becoming sleepy just stopping and going to bed.

One student, with vision, suggested following the regular print text while listening as a means of staying alert and another suggested injecting side noises on the tape as bells, buzzes, or cuckoos from a cuckoo clock at 15 minute intervals.

Although the problem of drowsiness is not unique to the listening situation, it is probably greater than in the more traditional study situations, the problem being passitivity rather than active involvement.

23. Concentration

Concentration, like drowsiness, is not always a problem but occasionally a problem for the majority of students. Only 28% could give an unqualified negative answer to the question, do you have trouble concentrating on your recorded material? Most students indicated that at

certain times under certain circumstances; such as after listening to material at a rapid rate for long periods of time, listening to dull material, using discs that hang up making it necessary for the user to hold the tone arm, or certain voice characteristics of the reader, their attention might wander. One student observed that the slow rate of presentation of recorded material caused thought to wander because the thought process is so much faster.

When asked about gimmicks used to improve concentration, several students mentioned taking notes or other forms of physical activity such as bouncing a rubber ball, rolling tapes, etc. Contrarily, one emphasized the necessity of not doing anything else simultaneously. Others suggested when concentration begins to wander to stop and mentally review, to get angry and go over the material again, to speed it up, or to just stop studying. One student reported that short breaks were of no help.

24. Study Procedures

Study for college students is paced by the more practical aspects of daily life; namely, assignments and scheduled appointments with readers. Some students reported that beyond meeting with their readers, they did not feel it necessary to budget their time while others felt it necessary to establish priorities and budget their time.

The great majority of students stated a preference for studying just one subject during any one study session. Many students reported using different readers for different subjects which, in effect, structured their study time. Regardless of study preferences, students must adjust to the demands of the moment such as daily assignments and maximum utilization of study time. Study habits were found to reflect these pressures.

No clear-cut patterns of preference emerged for massed or distributed study, though students reported certain academic subjects such as history and literature could be studied in massed segments while others such as mathematics, science, and foreign languages were more amenable to daily study. A student preferring massed study frequently would say he liked to do a whole week's reading at a sitting while another student preferring daily study would say he liked to study each subject each day in order to go to class prepared. Apparently, the manner in which assignments are given, the subject matter being studied, and the personality of each individual student all interrelate to determine personal study habits.

Closely related to massed and distributed study habits are the periods of time students reported listening at a sitting. These varied from one hour to all night with two and three hour periods being reported most frequently. It was noted that, along with assignments, author style, reader quality, and the student's interest in the subject matter contribute to the length of time a student will listen.

Practically all students reported they usually listened to a selection only once. When listening they listen carefully often going over anything that isn't clear and usually take notes. Time appears to be the limiting factor in study with students saying there just wasn't enough time to read over most things more than once. Subjects for which more than one listening was reported as necessary were mathematics, science, and foreign languages.

Reviewing notes, whether written or recorded, was found to be the primary way in which college students prepared for tests with 83% of the group interviewed reporting doing so. Other methods mentioned by from one to three students each were: reviewing summaries or conclusions, having one's reader skim the text and/or read passages in the text previously marked as important, skim recordings, relisten to critical material, reread, review workbooks, and study with other people.

Graphics present the greatest problem encountered in study from recordings. Because they usually contain important information, it is critical that it be communicated. Forty-four percent of the interviewees reported having their readers or other sighted person describe graphics to them. Often this may require going over them a number of times. Whether or not readers were requested to also interpret the graphic entirely depended on the wishes of the student. Twenty-two percent of the students reported having graphics redrawn either for tactual use (using tracing wheels, Elmers Glue, clay, string, rubber, etc.) or by having them enlarged for visual use. Another 22% of the students said they could use the graphics in the regular ink print texts either with or without the help of magnifying devices. The remaining 11% of the students said they could not understand graphics; therefore, just ignored them.

25. Notes

All students reported taking notes. The extent and type of notes taken and the manner in which they were taken varied. Methods of taking notes were found to be highly individualistic usually being determined by the individual's reading ability which, in turn, usually determined the final form, written or recorded, in which notes were desired.

Notes taken could be categorized as class notes or those made while studying. For the purpose of this study, study notes made while studying from written material will not be described.

The types of notes reported could be classified as outline, or itemization as of key terms. Summary notes might merely summarize an idea presented by paraphrasing it or be in the form of summarizing comments. Some students made notes only on material pertinent to the central theme of the subject under study while others noted specific detail, this being somewhat dependent on the subject matter and anticipated use of the notes.

Class notes were made in a variety of ways. Some students reported making them in the traditional way by writing them out in class using either braille or script; some of whom reported they later recorded these notes. Braille class notes were usually made with a slate and stylus with some students reporting writing them in a shorthand form or grade 3 braille. Some students, having limited vision, reported that use of a Flair pen satisfied their visual needs. It was found that some students who wrote out their class notes in script did not have enough vision to read what they had written. These students had to have them transcribed either in large type or recorded on tape by a sighted person. One student said that after having his written notes recorded, he would listen to them and then summarize them on another tape. Another student reported a similar procedure only differing in that the original written notes used were carbon copies of a classmate's and that the final form was braille. Other students choose to record lectures at the time and then, at their leisure, make notes in whatever medium preferred.

Fewer steps were reported in making study notes. Often these were made directly in their final form at the time of the initial hearing. However, other students, apparently, take notes and then, from these, make more concise notes.

Students usually organized their notes by topic and reported they were primarily used for review and in the writing of papers. One student reported that he anticipated using his notes for teaching purposes and others implied they would use theirs for future reference as when reviewing for more advanced degrees.

26. New Words

New words do not appear to present too severe a problem for the visually handicapped. When working with readers, the reader can be quizzed as to spelling or asked to look up a definition in either the textbook glossary or a dictionary at any time. Only the proper pronunciation of certain terms appeared to present difficulties and this is dependent upon the skill and background information of the reader. The spelling of new words in recorded material is frequently given when new words first occur. If not, the user can attempt to spell the word phonetically which he can verify or not as he sees fit. If an important new word is encountered when the user does not have access to a glossary or dictionary he can always make a note of it by either approximating the spelling or noting the page on which it occurred. With this information he can either look it up himself later of have a sighted person do so. Frequently the meaning of new words can be determined from the context. Most students make notes of important new words or terms.

The need for a larger braille dictionary and a thesaurus was evident from remarks made by the students.

27. Place Finding

Discs. Finding a desired place on a recording is not easy. Recorded print page numbers are the key to searching because, with this information, the proper disc and side can be located from information either on the label or on the disc jacket. Students reported that if the exact page is not known, knowing what the desired place is near helps. Often the exact page can be found from the index (if not included with the recorded edition, a sighted person can check the ink print editions) or the general span of pages determined from the table of contents. With the best information available as to location, the student must approximate the position and then try to find the exact place by scanning the recording or using a trial and error approach. Beeps marking the ends of chapters were reported as helpful when scanning.

Tapes. Several students noted that place finding is a greater problem with tapes than with discs. As with discs, page numbers are the key to searching and may be determined similarly. After ascertaining the desired page, the appropriate reel, side, and track can be identified and the position within approximated. The exact location can then be found by either scanning or searching by a trial and error approach. Use of odometers on tape recorders helps in approximating locations; however, when using more than one recorder, it may be found that the odometers are not calibrated. Another method of approximating locations cited was to estimate it from the amount of tape on the two reels.

Students reported two ways of indexing their own tapes. One was to insert a sound marker at 10 page intervals (some prerecorded material comes with blips already provided to be used for search purposes) and the other was, when having one's personal reader recording a book or selection, to have a space left between parts. Both of these techniques provide audible cues when running a tape through at the fast forward speed. One student noted it was helpful to have one's reader identify each track with book, chapter, and pages included.

28. Place Marking

In the interest of saving time and eliminating frustration, students reported it was always wise, using discs or tapes, to mark the place where stopping at the end of a study session. Several methods equally applicable for discs or tapes suggested were: (1) mentally, note and remember the position, (2) physically make a note as to position including such information as disc, side, and approximate position; or reel number, side, track, and approximate position (odometer reading if possible), and (3) just stopping the player and leaving the disc or tape on it. In addition, it was suggested that it was handy to stop at the end of a disc or reel or at some natural breaking point such as at the end of a chapter.

Several suggestions were made for marking tapes. One was that either lead tape or masking tape, both being sticky on one side but removable, could be used to actually stick onto the magnetic tape to mark a place. Caution must be used in not letting the marking tape feed through the pickup head. Another method suggested was to place a strip of paper in the reel before rewinding it. With this technique, the reel must be handled with care in order to keep the paper from falling out. Some tapes have sound signals especially provided for indexing purposes. These positions are readily discernible at the fast forward speed and; therefore, are excellent stopping places. Certain tape recorder models are equipped for the insertion of sound signals by the user thus providing another technique for marking a "sign off" point. For those who are able, use of the odometer gives a fairly precise measure of position.

29. Search Techniques

Finding a particular fact in a recording, whether it be disc or tape, is a difficult chore. Students reported that usually they could remember approximately where a sought fact occurred and searched via a trial and error method. A systematic approach to this method is the split half technique. This is accomplished by starting in the middle of the disc side or reel, side, and track judged to be the appropriate one. After sampling the midpoint content, a decision is made as to whether the desired portion comes before or after the sampled portion. If it is judged to be before, a sample is made at approximately the 1/4 position; if it is judged to be after, a sample is taken at the 3/4 position, and so forth until the sought portion is found.

Because of the time required and difficulties inherent in searching a recording, many students reported it was more expedient to have their reader or other sighted person search theink print edition for an elusive fact. After being found, it can either be read directly or information as to page number related. With the page number known, a student can select the proper disc and side; or reel, side, and track from indexing information which should be available and then search for the desired page. A problem encountered is that indexing information is not always as complete as it should be. One student suggested that more information could be included on the label of a disc if it were coded.

If a sighted helper is not at hand, a student must either rely on his memory, check his notes for leads, or consult the table of contents for cues as to location. It is in this instance that indices are critically needed but rarely available. Being familiar with the material was reported as being helpful in estimating locations.

30. Important Passages

In general there were two ways related of how to handle passages containing information to which a student might expect to want to refer again. One way was to make a note, written or recorded, of the information itself. The other way was to make a note of the exact location where the information could be found. For the latter way, the more complete the indexing information noted, the easier it would be to relocate it. It was suggested that with either of these systems the student could include information as to relative importance by including in the note expressions as, "Important," or "Very important," where appropriate. The possibility of marking the position on a tape by inserting an indexing tone was also mentioned as a possibility.

31. Aural Medium versus Written Medium Study Habits

The question, how does study from recordings differ from study with written books, evoked a number of statements reflecting individual preferences for written or recorded matter. The importance attributed to certain advantages inherent to study from the two media usually interacts with personal study skills to determine a person's preference.

Some of the advantages noted for study from written material cited were: (1) it is possible to do more initial scanning, (2) it is easier to do more skipping and skimming, (3) key words can be underlined in print books, (4) it is easier to reread a portion, (5) it is easier to get a frame of reference, (6) it is easier to concentrate on the material, (7) reviewing is easier, and (8) its use does not disturb other people.

The primary advantage to use of aural material cited was that it was much faster to use. Other advantages noted were that it is much less tiring to use than written material and; therefore, more enjoyable, that the listener can move around, and that discs and tapes are not as bulky to store or transport.

In comparing the two media, it was observed that written books can be used at school whereas recorded books usually have to be used at home. A difference of opinion was found concerning note-taking practices with some students feeling more notes are needed with aural material than with written material and others feeling about the same number of notes are needed with either medium.

32. Media Preference for Different Subjects

Academic subjects for which students preferred written books are those which are technical or detailed in content thus requiring rereading and reference back to and/or those subjects containing material written in other than a straight literary format. Students stated a preference for written textbooks for all mathematics and physical science courses

as algebra, geometry, trigonometry, statistics, physics, chemistry, biology, etc. Certain language books, too, were felt to be more useful in written form. This category included such material as grammar, poetry, and things written in a dialect as Old English. Certain specialized courses as those on computer language were also mentioned as being more easily handled when in written form. Many students mentioned wanting foreign languages to be presented in written form as this medium provides better access to prior examples, rules, and definitions. However, several other students mentioned the advantage of being able to hear the pronunciation of foreign words as provided through use of recorded books. Possibly the use of both media would provide the best means for learning a foreign language.

Academic subjects for which students preferred recorded material could be characterized as those subjects requiring extensive reading. Such subjects as economics, history, psychology, sociology, and literature would fall into this category.

Some pregnant observations made by students follow: "You must 'see' a complicated formula or proof written in order to understand it." "With poetry you need to observe stanza form and rhyme scheme which requires knowing the number of syllables per line and; therefore, where the line ends." "In chemistry you need to know how the print symbols look in order to communicate with your reader." "It is nice to have a written novel or something you can carry around with you."

33. Suggestions for More Efficient Use of Material and Equipment

Material. Several suggestions, not all mutually compatible, were offered to increase the usefulness of recorded material. Two suggestions were that indices be included and that both they and the tables of contents contain more complete indexing information, as, page number, disc, and side; or page number, reel, side, and track. Also suggested was that readers be instructed to point out topics and headings as they occur. A chapter outline, either written or recorded, was designated as a helpful study device along with written summaries. Although some students wanted page numbers to stand out, one suggested they were not needed at all. Pauses were noted as helpful at points where a student might want to make notes as after study questions. These pauses would need to be long enough to enable a user to switch his recorder off and then back on again without losing any of the recorded message. Another suggestion was that a book's format should be broken down and be recorded as separate parts. These could be separated by smooth bands on discs that would be tactually discernible. As expected, some students suggested that time compressed material be made available. One of the interviewees spoke adamantly on how disconcerting it was have anything interrupt the context.

Equipment. General comments made that would pertain to either disc or tape players were that they need to be small and compact (transitorized and portable) and that they need to have good fidelity. It was suggested that they be built to provide for instantaneous stopping and starting, that they be equipped with a pause device, that they have an automatic shut off mechanism, that they have a variable speed control or that they be equipped for speed reading (electronically), and that their tone controls be improved. The needs for remote control operating devices such as footpedals, for an extension speaker earphone, and for tabular indexing operations as on the Norelco dictation device were also expressed. One student noted that longer cords were needed for use with detachable speakers.

Suggestions specific to disc recorders were that they have inertia needles so that discs would not be as easily damaged, that the arm have detents for indexing purposes, that they be designed to operate in reverse, that they be built to go forward at a faster rate, and that they have an odometer showing number of revolutions. It was also suggested that players be equipped with an automatic reject mechanism so that discs may be stacked. This would suggest a change in the current arrangement of recorded material on discs as this would require that the first part of a recording appear on side one of disc one, the next part on side one of disc two, and so forth. Students mentioned the balance problem encountered when playing RFB discs on Talking Book Reproducers and stated a wish that it could be corrected. Certain merits of the Solocaster were pointed out as being highly desirable; namely, its portability, its variable speed operation, and its scanning device. A tremendous problem exists in manually scanning discs in that they are apt to become badly scratched often preventing further use.

A number of suggestions specific to tape recorders were offered. One was that they be easier to load or that ones using cassettes be perfected and put into common use. Several students suggested that multitrack recorders be used so that both content and indexing information could be included with one student suggesting that summarizing information could be recorded on one track. Mechanically, students stated a desire for more rapid fast forward and rewind action and for more reliable odometers. The desire for a battery operated recorder that would play seven-inch reels was expressed.

Apparently, there is a great need for a complete system that would provide a means for scanning recorded material.

Conclusions

Format

Subject matter was regarded the primary determinant of the best medium for text material, appendices, and notes. Although 83% of the students interviewed stated their preference, generally, for recorded text material, the consensus was that mathematics, physical science, and certain language books were more useful in written form. Appendices containing tables, graphics, and reference lists were also preferred in written form as were notes that contained graphics or references. The recorded form was preferred for appendices and notes containing all other types of information.

The majority of interviewees agreed that prefaces and/or forewords, acknowledgements, introductions, footnotes, and suggested activities sections should be in recorded form with the possible exception of footnotes of the reference type; and that tables of contents, graphics, study questions, bibliographies and/or references, glossaries, and indices should be in written form. Over a quarter of the students suggested that graphics could be more easily understood if they were both written out and aurally described.

Probably the main consideration in deciding whether material should be written or recorded is whether it will be read through once or whether it is something to which a student will need to refer. In the former instance, recordings will suffice and provide for more rapid use; in the latter, the written form enables greater facility of use. For the vast majority of students, probably some combination of the written and recorded forms would provide maximum efficiency of use. It was pointed out, emphatically, that there will always be a need for completely recorded material for use by non-readers, e.g., those adults who lose their sight and never learn to read braille with any degree of proficiency.

Study Techniques

The impression gained from these college students was that all were practical people who had worked out individual approaches to study, tailored to fit their individual needs. None had received formal instruction in how to use aural material though all were users of recorded material and/or reader services.

The composite image that emerged was one of serious students who could adapt their study patterns to meet their assignments and who strove to fully utilize time allocated for study. Study for them appeared to be somewhat paced by standing appointments with readers. Students reported preferring to study just one subject during any one study session.

and usually listening to a selection only once, taking notes at the time if necessary. They reported that certain subjects as history and literature could be studied in massed segments while others such as mathematics, science, and foreign languages were more amenable to distributed study. This difference was reflected in the wide range of time reported as typical study sessions. Two and three hour sessions were reported most frequently. Reviewing notes was the primary way reported for preparing for tests. Graphics, apparently, present the greatest problem in use of aural material. Although the majority of users reported normally having them verbally described, a substantial number reported having them redrawn for either tactual or visual use.

Distractions cited when using aural material fell into three general categories: environmental conditions such as noise, quality of the recordings such as scratches, and user characteristics such as degree of interest.

The majority of students reported that on occasions they would have difficulties concentrating on material presented aurally. Disciplining one's thoughts and taking notes were two suggestions made to help direct one's attention.

Fifty percent of the students reported drowsiness was occasionally a problem which is caused, in part, by the passivity of the listening condition. Taking short breaks, moving about, drinking coffee, and getting actively involved as by taking notes were ways suggested for combating drowsiness.

All students reported taking notes. These could be typed as summarizing, outline, or itemization notes and were taken at classroom and study sessions. Whether the notes were written or recorded initially, whether they were edited and/or transcribed or not, and whether their final form was written or recorded was entirely a matter of individual preference. Numerous techniques for handling notes were reported by the students.

A real problem in the use of recordings was found to be searching to find one's place or to refer back to something. This is a greater problem with tapes than with discs. Students reported that when leaving something to which the user will be returning, it is best to just stop the machine and leave it set up. If the tape or disc must be removed, the user should make a note, physically or mentally, of the exact location. Important passages should be either thoroughly noted at the time they occur or a note made of their exact location so that they may be found again. Recorded print page numbers were reported to be the key to searching. For this reason, indices for recorded material are critically needed. With or without information as to exact page number, a trial and error technique is usually used to locate any specific place.

Numerous suggestions were made for both material and equipment to make them easier to use. Among these, students suggested that recorded material contain more complete indexing information, that headings be made more conspicuous, and that pauses be left at places where a student might be expected to want to stop to make a note. Suggestions offered for equipment were of a mechanical nature and were directed toward making both disc players and tape recorders more suitable for study purposes.

To provide an optimal study possibility for visually handicapped students, both material and equipment should be designed especially for their use. This will necessitate a certain amount of rethinking on the part of both educators and manufacturers, but the ultimate goal is clear. It is to provide a total aural study system that will enable a student to learn with maximum efficiency.

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Aural Study Systems for the Visually Handicapped

Effects of Motivation and Word Rate on Aural Comprehension

June E. Morris and Carson Y. Nolan

American Printing House for the Blind, Inc.

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Department of Health, Education, and Welfare

U. S. Office of Education
Bureau of Education for the Handicapped

The purpose of this study was to test the effects of varying motivation on comprehension of material presented at three different word rates. A secondary finding of earlier research (Nolan, 1968), was that, when heard under motivated conditions, material of three different types was comprehended significantly better when heard at a normal rate than when heard at a rate slightly faster than normal.

Numerous studies (Foulke, 1968; Foulke & Sticht, 1957; Henry, 1966; Jester, 1966; Loper, 1966; Wood, 1965) have shown that the relationship between comprehension of aural material and word rate is a negative one. However, the point at which the decrease in comprehension becomes significant has never been clearly identified and has been reported at various rates. Generally, it has been thought that comprehension was not significantly affected at rates below 250-275 words per minute (wpm). Because of this, Nolan (1968) did not anticipate finding significant rate differences in his study in which only moderately compressed material, 225 wpm, and normal material, approximately 175 wpm, were used. When significant rate differences favoring the normal rate did occur, the role of motivation immediately became suspect; all subjects in this study having worked under motivating conditions. Nolan suggested that real differences may exist even at low levels of compression which only become apparent when subjects perform optimally as they might be expected to do when working under motivated conditions. The current study was designed to follow through on the earlier study by testing the role of motivation on the learning of aural material heard at normal and compressed rates.

Method

Design. Similar studies were designed for students in grades 4-7 and for students in grades 8-12. In each, subjects listened to literary material presented at one of three rates under either motivated or unmotivated conditions. Factorial designs involving random groups were used.

For the high school group, a 3 X 2 design was used with rate of listening and mode of listening being the treatments. The three rates of listening were 175 wpm (actual), 225 wpm, and 275 wpm. The two modes of listening were either under motivated or unmotivated conditions.

The 3 X 2 X 2 design used in the elementary grades was similar to the high school design but with a grade level factor included. The latter was included because previous research (Nolan, 1966) using the same materials, revealed grade level differences in the amount learned by elementary students. The two levels used in the current study were grades 4-5 and grades 6-7.

Subjects. All subjects were legally blind students enrolled in residential schools for the blind who were assigned to regular classes. One hundred twenty subjects were used at the high school level; 20 being in each of the six treatment groups. One hundred eight subjects were used at the elementary level; 18 being in each of the six treatment groups. Subjects in each of the elementary groups were divided equally so that half were from grades 4-5 and half from grades 6-7. Table 1 describes the composition of the groups.

TABLE 1

Subjects at Each Level in Each

Treatment Group

	Unmotivated			Motivated		
Grade Levels	175 wpm	225 wpm	275 wpm	175 wpm	225 wpm	104 wpm
4-5	9	9	9	9	9	9
6-7	9	9	9	9	9	9
8-12	20	20	20	20	20	20

Schools providing both high school and elementary subjects were the Nebraska School for the Visually Handicapped, the West Virginia Schools for the Deaf and the Blind, and the Wisconsin School for the Visually Handicapped. Additional elementary subjects were required and these were obtained at the Texas School for the Blind. With the exception of the Wisconsin school, all regular students enrolled in these schools at the appropriate grade levels who were present at the time the data were collected participated in the study. It was not necessary to use all of the students available at the high school level in Wisconsin so those students used were selected randomly from the total high school population.

Braille and print readers were used as they occurred naturally in the schools; however, initially, a stratified-random sampling technique (Guilford, 1956, pp. 158-159) was used in assigning subjects within a grade level (4-5, 6-7, 8-12) to treatment groups. For each school this was accomplished by first randomly assigning all braille reading students within a level to the treatment groups and then randomly assigning the print reading students within the same level to the treatment groups.

Where not all groups within a level contained an equal number of students of the same reading medium from a site, assignment of subjects of the other reading medium was made in such a way that subjects within a school were equally or nearly equally distributed among the six treatment groups. By assigning subjects to groups in this manner, the groups initially contained proportions of braille and print subjects representative of the school populations from which they were drawn.

Absenteeism and subjects lost due to their inability to perform the required task in the allotted time resulted in some attrition within the initial groups. Having anticipated some losses, more subjects were assigned to most of the groups than were required by the experimental design. After all data were collected, surplus subjects were randomly omitted within grade levels.

Material. Two literary selections were used that had been part of previous research examining the parameters of learning by listening. "A Battle over the Teacups" (Derleth, 1957) was heard by subjects at the high school level. The story contained 1970 words and had a reading difficulty appropriate for eighth and ninth grade students, as determined by Flesch's readability formula (Flesch, 1951). This difficulty level is typical of material appearing in high school literature texts. "Notch-tail" (Stauffer, Burrows, & Jones, 1962) was used by subjects at the elementary level. The version used contained 2114 words, the original version having been edited to shorten it slightly. Reading difficulty for this story, as computed by the Flesch formula, indicated it was appropriate for use by sixth grade students.

Both selections were recorded on magnetic tape by a professional reader in the recording studios at the American Printing House for the Blind (APH). These were then compressed to three different rates by a time sampling technique at the Center for Rate Controlled Recordings at the University of Louisville. The specifications for the resulting tapes were that they contain speaking rates of 175 wpm (actual), 225 wpm, and 275 wpm. Preceding each was a short sample taken from "History of Milling" (Buehr, 1959) recorded similarly and compressed to the same rates as the selections which followed.

Tests of comprehension for both selections were reproduced in braille and large type (18-point by APH standards). The tests for the high school and elementary selections were five choice multiple choice tests containing 70 and 65 questions, respectively. Reliability for the braille and large type editions of the tests ranged from .91 to .95 (Nolan, 1966).

Procedure. Subjects in motivated groups were told they had a chance to win two prizes. First, that each student earning the highest score on the test in his local group would receive a prize and, second, that all students in a local group would receive a prize if that group

had the highest average score among similar groups from all the participating schools. In the interschool competition, groups competed only with similar treatment groups. Students were informed that the prizes would be candy.

All students at a school assigned to the same treatment group worked together. Unmotivated groups were scheduled prior to motivated groups. One examiner could work with three groups during a school day. After determining the day for a given series, i.e. unmotivated high school groups, the order in which the three groups within that series were seen was determined by random means.

With each group, subjects were assembled, instructions read, the sample played, the selection played, test instructions read, and the tests administered. Playing the sample offered an opportunity for subjects to become acclimated to the listening environment, the reader, and the rate of presentation. Tests were given without time limits; however, in a few cases the demands of the schedule and/or school day required dismissing a subject before he had completed his test. In such cases, where the student had completed 85% or more of his test the score was prorated and used.

The tests were shipped back to the APH where they were scored and/or checked and the prizes shipped. To avoid feelings of unfair treatment, similar prizes to those for the winners in the motivated groups were sent to participants in the unmotivated groups. This procedure was explained to the administrators of the schools involved so that they could pass the word on to their students as they distributed the prizes.

Results

Results of this study fail to substantiate Nolan's earlier finding (1968) that aural material is comprehended better when heard at normal rates than when heard at 225 wpm. Also, the findings do not support the hypothesis that motivation is related to this occurrence.

Reference to Table 2 shows that rate of presentation was the only factor significant (.01 level) to learning aural literary material for high school students. A glance at Table 3 verifies that as rate of presentation increased, comprehension decreased. Differences in learning between motivated and unmotivated groups were not significant nor was there any significant interaction between motivation and rate.

TABLE 2

High School Analysis of Variance Summary

Source of Variation	df	Sums of Squares	Mean Squares	F
Rate (R)	2	2,926.67	1,463.34	11.90**
Mode (M)	1	76.80	76.80	.62
R x M	2	77.40	38.70	.31
Within Cells	114	14,023.10	123.01	
Total	119	17,103.97		

**Significant at the .01 level

TABLE 3

Means, Standard Deviations, Ranges, and Number of Subjects at the High School Level

	Unmotivated			Motivated		
Grades 8-12	175 wpm	225 wpm	275 wpm	175 wpm	225 wpm	275 wpm
Mean	39.4	38.8	29.1	39.9	35.4	27.2
S. D.	13.0	11.6	11.5	10.5	10.9	8.5
Range	16-56	15-57	9-55	21-60	18-64	11-46
N	20	20	20	20	20	20

Differences significant at the .05 level were found for rate and, as expected, grade level for the elementary group. Table 4 shows that these were the only significant differences occurring within this group. As with the high school students, the relationship between

comprehension and word rate was a negative one. Table 5 shows this to be true for all elementary subgroups.

TABLE 4

Elementary Analysis of Variance Summary

Source of Variation	df	Sums of Squares	Mean Squares	F
Rate (R)	2	1,335.36	667.68	4.66*
Grade Level (GL)	1	966.02	966.02	6.75*
Mode (M)	1	60.76	60.76	.42
R x GL	2	6.24	3.12	.02
R x M	2	48.16	24.08	.17
GL x M	1	420.08	420.08	2.93
R x GL x M	2	70.39	35.20	.24
Within Cells	96	13,741.33	143.14	
Total	107	16,648.34		

* Significant at the .05 level

TABLE 5

Means, Standard Deviations, Ranges, and Number of Subjects at the Elementary Levels

	Unmotivated			Motivated		
	175 wpm	225 wpm	275 wpm	175 wpm	225 wpm	275 wpm
Grades 4-5						
Mean	38.0	35.8	31.4	34.8	29.4	24.7
S. D.	13.5	11.1	12.1	12.6	13.9	7.2
Range	16-53	12-46	15-52	15-49	9-48	16-36
N	9	9	9	9	9	9
Grades 6-7						
Mean	41.2	39.4	30.7	43.3	39.0	36.3
S. D.	11.4	17.4	7.4	9.7	11.6	12.0
Range	21-59	15-59	20-43	23-56	19-52	16-54
N	9	9	9	9	9	9

Several t tests were run to analyze further the differences in the means for the different rate groups. These revealed that high school students learned significantly more at both 175 wpm and 225 wpm than they did at 275 wpm while elementary students learned significantly more at 175 wpm than at 275 wpm. All of these differences were significant at the .01 level of confidence.

Conclusions

With the exception of the expected significant grade level difference found for elementary students, comprehension of literary material appeared to be affected only by rate of presentation; comprehension and word rate being negatively related. Blind students at both high school and elementary levels learned more from material heard at the slower rates. Learning appeared to be unrelated to motivation.

In reviewing Nolan's earlier study (1968) in light of the current study, it appears that the rate differences reported were unrelated to motivation. In addition to the differences in learning found for material presented at different rates, there is a possibility that the length of the segments heard, the presence and/or length of the pauses involved, or the total study time involved may have had a bearing on learning. Recent research has identified these factors as possibly influencing aural learning. Further research will be necessary to follow this up.

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Aural Study Systems for the Visually Handicapped

Some Parameters of Learning by Listening

June E. Morris and Carson Y. Nolan

American Printing House for the Blind, Inc.

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Department of Health, Education, and Welfare

U. S. Office of Education
Bureau of Education for the Handicapped

Since the early sixties, research has been underway at the American Printing House for the Blind (APH) exploring the processes involved in aural learning by the blind. Interest originally stemmed from the fact that the aural medium is a faster means of communication than the written medium for the majority of legally blind students. The specific aims of the initial research project entitled "Reading and Listening in Learning by the Blind" were:

1. To determine the relative efficiency of listening and braille or large type reading as a means of learning subject matter of different types.

2. To determine the relative efficiency of different rates of auditory communication for learning subject matter of selected types.

3. To identify listening techniques useful for learning by the blind.

The purposes of the project were accomplished and have been reported by Nolan (1966, 1968). A subsequent project entitled "Aural Study Systems for the Visually Handicapped" was then undertaken to follow through with the research. The goals for this project were to develop an entire system of study using recorded texts and to further study variables affecting learning through listening. This report describes efforts directed towards the latter goal.

The research to be described deals with amounts of time and distribution of practice in aural study. The purpose of the first study was to determine the degree to which learning was enhanced through repeated exposure to aural material heard at one study session. The second part of the report will briefly review the findings of previous reading and listening research relevant to amounts learned via reading and listening. Part three will then relate the findings of the earlier research to findings of the current research to determine the relative efficiency of learning through reading and listening when study time is held constant. The fourth part will compare learning through listening when practice is massed and distributed. As in part three, this will be accomplished by comparing the findings of the earlier research (distributed practice) with the findings of the current research (massed practice). The fifth and final part will then tie together the findings of the preceding parts.

Search of the literature revealed only two studies concerning amount of time and distribution of practice in aural study. One study (Fairbanks, Guttman, & Miron, 1957) related learning resulting from one and two consecutive listenings to material when presented at normal rates and under conditions of 50% compression. Subjects were adults. Learning

was found to be significantly and positively related to number of presentations. However, with presentation time held constant, listening twice to a selection compressed 50% yielded no more learning than listening once at the normal rate. In the other study (Sticht, 1969) groups of adults heard a message twice, in various combinations of compression, in approximately the same amount of time required by similar groups to hear it once at the normal rate. No increase in learning resulted from the double presentations under these conditions.

Part One

The Effects on Learning of Repeated Continuous Listening

While interviewing blind students who traditionally studied using aural material, it became quite apparent that their study techniques varied (Morris & Nolan, 1968; Nolan, 1966) However, several common trends were apparent. Some students listened to their recorded book only once and thereafter studied from written notes. All college level students and the majority of high school students interviewed reported note-taking as being of prime importance. Another technique frequently mentioned was repeated listenings to material either in toto or in part.

The current study was designed to test the effects on learning of hearing material either two or three times consecutively. Two and three listenings were of specific interest for two reasons. First, the average blind student is such a slow reader he is able to listen to something played at the normal rate two to three times in the same amount of time it would require for him to read it once. And, second, so that learning resulting from massed practice (listening three times consecutively) could be compared with learning resulting from distributed practice (listening to the material one time on each of three consecutive days) for which data were available (Nolan, 1966).

Method

Design. Two studies of duplicate design were conducted to determine the effect on learning of multiple consecutive listenings to textbook type material. One study examined literary material, the other scientific material. With each type of material parallel studies were conducted using high school and elementary level students. A factorial design of the 2 X 3 type was used for the two high school studies and one of the 2 X 3 X 3 type for the two elementary studies. In all studies the treatments were type of reader (braille or print) and number of times the material was heard (once, twice, or three times). Additionally, a grade level factor (grade four, grade five, and grade six) was included with the elementary studies as previous research (Nolan, 1966; 1968) revealed significant grade level differences in the amount learned by students in the elementary grades.

Subjects. All subjects were legally blind students enrolled in regular classes at either residential schools for the blind or in public school systems. A total of 576 students participated; 144 in each of the four separate studies (high school literature, elementary literature, high school science, elementary science). Half in each study were braille readers, half print readers. No subject participated in more than one study. The composition of the high school groups is shown in Table 1.

TABLE 1

Model for the Treatments X Treatments

Design Used in the Two High School Studies

	Braille Students	Print Students
Once	24	24
Practice Twice	24	24
Three Times	24	24

High school subjects included students in grades 9, 10, 11, and 12. Those taking part in the literature study were drawn from the state residential schools for the blind in Arkansas, Maryland, and Virginia and the Atlanta, Philadelphia, and San Diego public school systems. Those participating in the science study were enrolled at the Georgia and Kansas residential schools and the public school systems of Atlanta and Columbus, Ohio as well as the following California school systems: Azusa, Berkeley, Garden Grove, Long Beach, Mt. Diablo, Pasadena, San Bernardino, and San Francisco.

Elementary subjects were restricted to students in grades 4, 5, and 6 with equal numbers coming from each of the three grades. Those participating in the literature study came from the Arkansas, Kentucky, Maryland, and Virginia residential schools for the blind and the public school systems of Atlanta, Cleveland, and Philadelphia; and Berkley, Castro Valley, San Francisco, and Walnut Creek, California. Those taking part in the science study came from residential schools in Georgia, Kansas, North Carolina, South Carolina, and Tennessee; the Columbus, Ohio public schools and public schools in California at Azusa, Berkeley, Garden Grove, Long Beach, Mt. Diablo, Pasadena, San Bernardino, San Diego, and Walnut Creek. Table 2 describes the compositon of the groups for the elementary studies.

TABLE 2

Model for the Treatments X Treatments X

Levels Design Used in the Two Elementary Studies

	Braille Students			Print Students		
Levels (Grades)	4	5	6	4	5	6
Once	8	8	8	8	8	8
Practice Twice	8	8	8	8	8	8
Three Times	8	8	8	8	8	8

The percent of braille and print readers from residential and public schools at both levels is shown in Table 3 for the literature studies and in Table 4 for the science studies.

TABLE 3

Literature

Percent of Braille and Print Readers from Residential

and Public Schools in Elementary and High School Groups

	High School		Elementary		Total	
	Residential	Public	Residential	Public	Residential	Public
Braille	68.1	31.9	79.2	20.8	73.6	26.4
Print	65.3	34.7	45.8	54.2	55.6	44.4

TABLE 4

Science

Percent of Braille and Print Readers from Residential and Public Schools in Elementary and High School Groups

	High School		Elementary		Total	
	Residential	Public	Residential	Public	Residential	Public
Braille	38.9	61.1	79.2	20.8	59.0	41.0
Print	54.2	45.8	36.1	63.9	45.1	54.9

Material. The selections, their tests, and the recordings used in this project were the same ones used and thoroughly described in earlier research on listening conducted by APH (Nolan, 1966) except that all large type materials used in the current research were produced in 18-point type, as determined by APH standards. The materials are described in Table 5.

TABLE 5

Description of Listening Selections and Tests of Comprehension Accompanying Them

	Selections	No. of Words	Reading Diff. Grade Equiv.	No. of Test Questions	Chance Score	Test Reliability
H. S.--Lit.	A Battle over the Teacups*	1970	8th-9th	70	14	Br. .94 Pt. .91
Elem.--Lit.	Notch-tail**	2114	6th	65	13	Br. .95 Pt. .92
H. S.--Sci.	The Land beneath the Sea***	2071	10th-12th	74	15	Br. .87 Pt. .93
Elem.--Sci.	The Gulf Stream****	2102	7th	72	14	Br. .90 Pt. .76

Note.--Reading difficulty was determined by the Flesch formula (1951).

* (Derleth, 1957)

** (Stauffer, Burrows, & Jones, 1962)

*** (Arnou, 1962)

**** (Malkus, 1956)

The four selections were professionally recorded by a male reader on magnetic tape at 3-3/4 inches per second (ips) and were played at the rate at which they had been recorded. The approximate word per minute (wpm) rate for each was as follows: "A Battle over the Teacups," 164 wpm; "Notch-tail," 171 wpm; "The Land beneath the Sea," 153 wpm; and "The Gluf Stream," 164 wpm. As can be seen, the reading rates varied even though all selections were read by the same reader. This occurred because reading rates are influenced by such things as word length, sentence length, content, and style.

Each of the recorded selections was copied onto tapes for experimental use three times consecutively so that the selection could be played once, twice, or three times without rewinding. A five second pause was left between the first and second and second and third presentations so that the recorder could be stopped and started again where appropriate. Good quality recorders of several makes were used to play the tapes. Playing times are given in Table 6.

TABLE 6

Approximate Time Required to Play the Selections

Selections	Once	Twice	Three Times
A Battle over the Teacups	12'21""	24'42"	37'03"
Notch-tail	12'03"	24'06"	36'09"
The Land beneath the Sea	12'51"	25'42"	38'33"
The Gulf Stream	13'34"	27'08"	40'42"

The tests of comprehension accompanying the selections were five choice multiple-choice tests. They were reproduced in standard press braille and large type which was 18-point by APH standards. The format of the tests was the same as that customarily used for achievement tests. These tests were designed to be given without time limits.

Procedure. All residential schools and most, 10 of 15, public school systems from which subjects were drawn were selected specifically for participation in either the literature or science studies. Students in the other five participating public school systems were assigned where most needed. For example, in San Francisco elementary students took part in the literature study while high school students took part in the science study. In deciding which study the school or school system was to be a part of, the primary factor considered was whether students were contaminated by having previously participated in research where the same material had been used. This was an important consideration as the experimental materials had been in use for the preceding four/five years. Other factors considered were the composition of available students at a school or within a community as to grade level and reading medium.

Rosters of eligible students were obtained from each of the participating schools or school systems. These gave the name, grade assignment, and reading medium of potential subjects. Students who were shown as reading both braille and print were eliminated. Others listed on the roster were then randomly assigned to the experimental groups. The three experimental groups provided for the three expermental conditions; namely, whether a subject heard the material one, two, or three times consecutively. Braille reading and print reading students were separated and assigned to groups independently of each other at both the high school and elementary levels. Additionally, with elementary students, a stratified-random sampling technique (Guilford, 1956, pp. 158-159) was used to provide for the grade level factor in the experimental design. Essentially, this meant that independent random assignments were made for braille elementary students at each of the three grades included and, likewise, for print elementary students.

Surplus students were assigned to groups where possible to provide for any lost through absenteeism or for any who might not be able to perform the task adequately. After all data were in, subjects were randomly omitted from groups containing extras. This was done within grade levels for the elementary groups.

The order in which the groups were seen in residential schools was initially determined by random means. However, the order sometimes had to be shifted to fit the school day. In public schools the order in which subjects were seen was a matter of expediency. That is, student A might be seen first and student D next. The determining factor as to why student D was seen before students B and C was that student D's school was closer to student A's school than the other school(s) involved.

The task for the subjects was to listen to a selection either one, two, or three times and take a multiple-choice test of comprehension on the selection immediately following the final hearing. For those hearing it more than once, short breaks were given between presentations. Braille and print subjects assigned to similar groups worked together at a site. All subjects marked their answer choices directly in their test booklets.

Time allotted for the groups were:

Group I	one hour, thirty minutes
Group II	one hour, forty-five minutes
Group III	two hours

These times were generous to allow for slower students. Most students finished in considerably less time. If, at the end of the allotted time, a subject had not completed 85% of the test, he was dismissed and dropped from the experimental group. If a subject had completed 85% or more of his test, a score was prorated for him for the total test and he was retained as a subject in his experimental group.

An attempt was made to motivate all subjects by conducting the data collection phase of the studies as contests. Residential school subjects were seen in groups. Each was told that the person scoring highest on the test in their group would win a prize. Additionally, each group was told that every member had a chance of winning a prize. To do so, their group would have to earn an average score higher than the average score earned by any similar group at one of the other residential schools participating in the study. Because public school subjects were seen either individually or in small groups, it was necessary to conduct a slightly different type of contest for them. These students were told that, within their community, several other students were doing exactly the same thing as they and that, from among them, the student earning the highest score on the test would win a prize. In all cases subjects were told the prizes would be candy.

Results

High school literature. An analysis of variance, reported in Table 7, revealed a difference significant at the .01 level for practice within this group. Reference to Table 9 shows that, for both braille and print reading students, learning of literature was positively related to practice. No significant differences occurred in learning between the two types of readers nor for the interaction between type of reader and practice.

The range of scores for the high school literature group was from 13 to 66. Seventy was the maximum score possible. Means and standard deviations for the six subgroups appear in Table 9.

Elementary literature. Differences between the means for all main effects and their interactions for this group were analyzed and are presented in Table 8. The only differences that were found to be statistically significant were those for grade level and these were significant at the .01 level. It can be seen from the means presented in Table 9 that students in the sixth grade worked at a higher level than those in the fourth and fifth grades who performed similarly.

Although practice was not found to be significantly related to learning, it is interesting to note the trends implied. Overall, when means for the three practice groups are compared, it appears that maximum learning occurred when the material was heard twice. However, this is by no means a clear-cut trend as closer scrutiny of the means reveals that in three of the six subgroups (grade by type of reader) learning may have actually diminished with additional exposure to the material. Additionally, it might be noted that both fourth grade groups exhibited this negative trend.

Out of a possible maximum score of 65, scores for this group ranged from 7 to 60. Variability among the experimental groups is reported in Table 9.

TABLE 7

Literature

High School Analysis of Variance Summary

Source of Variation	df	Sums of Squares	Mean Squares	F
Type (T)	1	37.01	37.01	.21
Practice (P)	2	3,602.89	1,801.44	10.14**
T X P	2	138.89	69.44	.39
Within Cells	138	24,517.87	177.67	
Total	143	28,296.66		

** Significant at .01 level (6.82 with 1 df, 4.76 with 2 df)

TABLE 8

Literature

Elementary Analysis of Variance Summary

Source of Variation	df	Sums of Squares	Mean Squares	F
Type (T)	1	327.00	327.00	2.38
Practice (P)	2	482.39	241.20	1.76
Grade Level (GL)	2	1,521.72	760.86	5.55**
T X P	2	217.39	108.70	.79
T X GL	2	420.23	210.12	1.53
P X GL	4	904.44	226.11	1.65
T X P X GL	4	278.70	69.68	.51
Within Cells	126	17,281.12	137.15	
Total	143	21,432.99		

** Significant at .01 level (6.84 with 1 df, 4.78 with 2 df, 3.47 with 4 df)

TABLE 9

Literature

Means and Standard Deviations of Correct

Scores on Tests Made by Each Subgroup

	Group I		Group II		Group III	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
			High School			
Braille	37.96	11.46	46.38	14.33	52.29	13.58
Print	41.75	14.40	46.00	15.23	51.92	10.28
			Elementary			
Braille						
grade 4	44.62	15.71	40.12	13.46	37.88	7.18
grade 5	30.62	16.40	40.50	11.77	41.62	10.27
grade 6	50.00	7.56	49.38	6.91	47.75	11.13
total	41.75	15.62	43.33	11.44	42.42	10.14
Print						
grade 4	38.38	10.81	38.12	14.97	35.75	12.80
grade 5	33.75	13.93	47.38	4.41	35.75	14.65
grade 6	39.25	11.67	45.88	10.45	41.12	8.32
total	37.12	11.92	43.79	11.16	37.54	11.96

High School science. Within this study, means for both main effects, type and practice, were significantly different; type at the .01 level and practice at the .05 level. Braille reading students learned more than did their print reading counterparts and, overall, learning increased with additional exposure to the material. Results of the analysis of variance are given in Table 10.

The scores for this group ranged from 12 to 66 out of a maximum possible score of 74. Means and standard deviations for the groups within the experiment appear in Table 12.

Elementary science. The summary of the analysis of variance used to evaluate performance in this study is presented in Table 11. The only differences occurring that were significant were for grade level and these were significant at the .01 level. Generally, as can be observed from Table 12, learning was positively related to grade placement. There were no significant differences between types of readers for this group nor was additional practice found to improve performance. In fact, with three of the grade groups (braille 4 and print 5 and 6) practice and performance appeared to be negatively related.

Out of a possible score of 72, individual scores ranged from 10 to 54. Standard deviations for the experimental groups are given in Table 12.

TABLE 10

Science

High School Analysis of Variance Summary

Source of Variation	df	Sums of Squares	Mean Squares	F
Type (T)	1	1,369.00	1,369.00	6.98**
Practice (P)	2	1,658.01	829.00	4.23*
T X P	2	402.04	201.02	1.02
Within Cells	138	27,062.17	196.10	
Total	143	30,491.22		

* Significant at .05 level (3.91 with 1 df, 3.06 with 2 df)

** Significant at .01 level (6.82 with 1 df, 4.76 with 2 df)

TABLE 11

Science

Elementary Analysis of Variance Summary

Source of Variation	df	Sums of Squares	Mean Squares	F
Type (T)	1	57.51	57.51	.54
Practice (P)	2	27.13	13.56	.13
Grade Level (GL)	2	1,873.63	936.82	8.87**
T X P	2	147.92	73.96	.70
T X GL	2	311.01	155.50	1.47
P X GL	4	59.74	14.94	.14
T X P X GL	4	345.12	86.28	.82
Within Cells	126	13,310.38	105.64	
Total	143	16,132.44		

** Significant at .01 level (6.84 with 1 df, 4.78 with 2 df, 3.47 with 4 df)

TABLE 12

Science

Means and Standard Deviations of Correct

Scores on Tests Made by Each Subgroup

	Group I		Group II		Group III	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
			High School			
Braille	35.08	13.10	44.12	12.77	43.62	16.76
Print	31.62	12.20	33.25	11.63	39.46	16.64
			Elementary			
Braille						
grade 4	21.50	7.29	19.62	9.36	17.38	4.24
grade 5	25.50	14.61	33.62	14.18	30.12	9.09
grade 6	28.88	10.09	28.38	11.21	29.25	11.16
total	25.29	11.03	27.21	12.69	25.58	10.19
Print						
grade 4	22.00	5.13	19.25	4.62	22.50	12.81
grade 5	27.62	10.61	22.12	6.88	23.75	12.76
grade 6	30.12	11.22	29.25	12.07	26.25	9.36
total	26.58	9.62	23.54	9.15	24.17	11.34

Discussion

One finding, immediately apparent in the data, is the difference in learning through repeated listening between the high school and elementary groups. Repeated listening resulted in significant increases in learning for the high school students, but not for the elementary students. Consequently, the results for these groups will be discussed separately.

High school. As just indicated, high school students learned through repeated listening. For literature, learning from three listenings was 31% greater than that for one listening while for science three listenings resulted in 24% more learning. Inspection of figures 1 and 2 reveals that learning increased progressively over the three trials for massed listening. Only the curve for the braille science group shows signs of leveling off. It appears that, generally, further practice would have resulted in further increase.

Amounts of learning for braille and print students were the same. There was a significant difference between braille and large type students for the science study. However, this apparently arose from initial differences in learning science materials through listening since increments in learning over the practice dimensions were the same for both groups. One source of this constant difference could have been differences in mental ability between these groups. It was not possible to test this hypothesis due to lack of available IQ scores for many members of the groups. A second source of the consistent differences may be the fact that braille students may be more accustomed to gleaning facts and to learning through listening. Such differences might become more apparent as material grows more difficult. Table 5 indicates differences in reading difficulty in the required direction for the materials used in this study.

Elementary. Learning by elementary students, unlike high school students, was not positively related to number of consecutive exposures to the material nor to whether the subjects read braille or print. It did appear to be positively related to grade level as is illustrated in tables 9 and 12.

The means presented in Table 12 indicate that learning for the science material was not great. These means ranged from 19-30 while a score of 14 chould have been achieved by chance. These effects were most prominent among fourth grade participants.

It is possible that the written tests of comprehension that were used may have been too difficult for some of these students. Table 5 shows that the selections used in the elementary grades had sixth and seventh grade levels of difficulty as determined by Flesch's reading ease formula (1951). However, as can be seen from Table 9, considerable learning occurred for the literary material which, though easier in content, was similar in language level. It is possible that students at the elementary level are not sufficiently skilled in listening techniques to be able to interpret difficult material when presented aurally. Another possibility is that these elementary level students did not have sufficient knowledge of scientific concepts, e.g. ocean currents, to be able to comprehend what they were hearing. Franks and Nolan (1970) have provided evidence that blind students suffer a severe deficit in knowledge of geographic concepts. If this is so, it is probable that they also are lacking in other scientific concepts.

A finding of great interest was that learning of elementary groups did not increase with increasing amounts of practice. The curves for learning through massed listening by this group are presented in figures 3 and 4. These indicate that some very slight increase in learning may occur with two successive presentations. However, learning is degraded by further practice.

It is not obvious from the data why this occurred. The motivating conditions of the experiment would certainly lead to other expectations. The most parsimonious explanation is that the repeated listening requirements exceeded the attention span of the elementary participants. The mean data in tables 9 and 12 present no real systematic patterns but give some hint of greater decrements for the fourth grade. This finding would support the attention span explanation. In addition, for the treble listening group total listening time was about 41 minutes. Listening this long and then being required to take a lengthy (65-72 item) test may have been a task of sufficient magnitude to offset the motivating conditions built into the experimental design. Consequently, test performance also may have been degraded.

Both high school and elementary level students expressed some resistance to having to listen repeatedly to the same material. Even so, the older students could be expected to appreciate the implications of the research and; therefore, probably were willing to exert more effort to cooperate with the task than were their less sophisticated younger colleagues.

Conclusions

For high school students, repeated listening resulted in significantly increased amounts of learning. Increases in learning appeared greater for literary material (31%) than for science (24%). Braille readers learned significantly more through listening than did

print readers when science material was studied. However, for both types of material, the rates of increase in learning with repeated listenings appeared better for braille readers. Further increases in learning through additional listening appeared possible.

Such was not the case for elementary students. Only grade level was significantly related to performance with this group. Effects of repeated listenings varied from grade to grade and between the two types of readers. For many of the subgroups learning actually decreased with additional exposure to the material. This was particularly evident among the fourth grade groups and may be related to attention span.

Consequently, while it appears that high school students derive considerable benefit in listening to material two or three times running, such is not the case for elementary level students.

Part Two

Previous Research on Reading and Listening in Learning by the Blind

Learning by reading and learning by listening were compared for high school and elementary students in order to determine the medium providing for greatest efficiency of learning for three different subject matters: literature, science, and social studies (Nolan, 1966). Only the results of the literature and science studies will be reviewed here as they are the ones pertinent to the current research.

Separate but parallel studies were conducted for each subject matter for high school students and for elementary students. A (2 X 2 X 2 X 3) factorial research design was employed. Treatments in each of the studies were mode of learning (reading or listening), type of reader (braille or print), and amount of practice (one-day or three-day). Grades constituted levels for each study. In the high school literature study the levels were grade nine, grade ten, and grade eleven. Levels in the high school science study were like those in the high school literature study except that grade twelve was combined with grade eleven in the highest level. In the elementary studies the levels were grade four, grade five, and grade six. One hundred ninty-two subjects participated in each of the four studies; eight subjects being utilized in each cell.

All subjects were legally blind students enrolled in regular classes at either public or residential schools. A criterion for braille students was that they had used braille for a minimum of one year.

The two literary selections and the two science selections, along with their tests, were the same ones as used in the research reported in part one; although, the print literary reading selection and test were produced in 16-point (by APH standards) type rather than the customary 18-point as were the science materials and all large type materials used in subsequent research. Likewise, the recorded editions of the selections were the same as those used in the research reported in part one.

Subjects worked either individually or in groups after having been randomly assigned to one of four experimental treatment groups. For each of the studies these groups were one-day reading, three day reading, one-day listening, and three-day listening. Subjects in the three-day groups read or heard the appropriate material once on each of three consecutive days. Following their last exposure to the material, all subjects were required to take the tests of comprehension previously described.

Reading times were determined for all subjects in the reading groups by timing them as they read their material for the first time. These times represent realistic study times as the subjects were working under instructions to read carefully as they would be tested on what they had read.

No external motivation was used in these studies beyond the usual plea for cooperation.

Results of these studies are summarized in tables 14 and 15. Efficiency scores for learning were computed by dividing mean comprehension test scores for each group by the mean time necessary for reading or listening.

TABLE 13

Percent of High School Students Enrolled in Residential and Public Schools Scoring Above and Below the Group Medians as Divided by Reading Types

Residential Schools

	Literature		Science	
	Braille	Print	Braille	Print
Above Median	46.9	55.3	57.1	48.7
Below Median	53.1	44.7	42.9	51.3

Public Schools

	Literature		Science	
	Braille	Print	Braille	Print
Above Median	56.5	40.0	45.5	51.5
Below Median	43.5	60.0	54.5	48.5

TABLE 14

A Selected Report of Research Findings: Reading and Listening in Learning by the Blind

	Literature				Science			
	High School		Elementary		High School		Elementary	
	Braille	Print	Braille	Print	Braille	Print	Braille	Print
wpm read	74	80	60	74	65	82	50	71
wpm read	164	164	171	171	153	153	164	164
Efficiency								
Listening to Reading	183%	207%	320%	213%	248%	191%	284%	190%
Sig. Dif.*								
Mode (M)	Sig. .05 level favoring reading		———		———		———	
Type (T)	———		———		Sig. .05 level favoring braille		Sig. .01 level favoring braille	
Practice (P)	Sig. .01 level favoring 3-day		Sig. .01 level favoring 3-day		Sig. .01 level favoring 3-day		Sig. .01 level favoring 3-day	
Grade Level (GL)	———		Sig. .01 level favoring higher		———		Sig. .01 level favoring higher	
Interactions	Sig. .05 level P X GL		———		———		Sig. .01 level P X GL	

* As determined by analyses of variance (F)

TABLE 15

Reading and Listening in Learning by the Blind

Summary Table of Means and Standard Deviations

(N=24 in Each Group)

	Reading				Listening			
	One-Day		Three-Days		One-Day		Three-Days	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
High School								
Br.--Lit.	44.75	14.59	55.00	10.91	39.88	11.83	48.75	10.98
Pt.--Lit.	41.71	12.22	51.50	11.30	39.04	12.70	49.50	11.50
Br.--Sci.	39.96	9.51	43.25	15.80	40.08	12.55	43.75	12.95
Pt.--Sci.	34.79	13.04	44.67	12.22	32.21	12.03	36.08	13.01
Elementary								
Br.--Lit.	37.46	14.69	48.25	12.46	36.88	14.39	47.04	10.29
Pt.--Lit.	39.25	14.02	39.12	14.96	33.83	11.38	45.88	13.00
Br.--Sci.	26.75	9.70	31.58	14.92	24.00	10.83	29.92	14.17
Pt.--Sci.	21.46	6.23	27.62	12.71	19.79	6.45	25.29	11.45

There are three things that should be specifically noted from the information provided in tables 14 and 15. First, in all cases listening proved to be the medium providing the greatest efficiency of learning. Second, learning was significantly (.01 level) and positively related to practice which, in this case, was distributed. And, third, with both elementary groups a significant (.01 level) grade level difference was found. Reference to the full report shows that learning by elementary level students positively reflected grade placement, i.e. students in the sixth grade learned more than those in the fifth, etc.

Part Three

The Relative Efficiency of Learning through Reading and Listening when Study Time is Held Constant

Table 14 shows that when learning efficiency is computed in terms of amount of learning per unit of time, listening was from 183-320% more efficient than reading. By combining the results of research reported in parts one and two, it is possible to compare learning through reading and listening when study time is approximately constant. The purpose of doing so was to determine whether, during any given period of time, greater learning can be achieved by a student reading the material he is studying once or by hearing it two or more times consecutively.

As in computing efficiency per unit of time, separate analyses were run for high school and elementary level students of both reading types (braille and print), and for easy (literature) and difficult (science) subject matters. Each treatment group contained 24 subjects.

In order to make these comparisons it was necessary to compare the amount of time required for the appropriate material to be read once by readers of both types and to be heard two and three times consecutively. Tables 5 and 14 provide the information necessary to calculate reading times and Table 6 presents the times required for listening. A comparison of this information is found in Table 16. It can be seen that reading time for elementary braille groups approximated that required to hear the same material three times. For all other groups, reading time more closely approximated the time required to hear the material twice.

A comparison of learning achieved for one reading (from Table 14) with learning for two or three consecutive listenings (from tables 9 and 12) is presented in Table 17.

TABLE 16

A Comparison of the Approximate Time Required to Read Once or Hear Two or Three Consecutive Presentations of the Stimulus Materials

Time in Minutes

	Braille		
	one reading	two consecutive listenings	three consecutive listenings
H. S.--Lit.	27	25	37
Elem.--Lit.	35	24	36
H. S.--Sci.	32	26	39
Elem.--Sci.	42	27	41

	Print		
	one reading	two consecutive listenings	three consecutive listenings
H. S.--Lit.	25	25	37
Elem.--Lit.	29	24	36
H. S.--Sci.	25	26	39
Elem.--Sci.	30	27	41

TABLE 17

A Comparison of Learning Achieved by Reading and Listening

Where Total Time Is Approximately Constant

Learning Represented by Group Means

	Braille			
	one reading	two consecutive listenings	three consecutive listenings	t
H. S.--Lit.	44.75	46.38	-	.383
Elem.--Lit.	37.46	-	42.42	1.333
H. S.--Sci.	39.96	44.12	-	1.253
Elem.--Sci.	26.75	-	25.58	.399
	Print			
	one reading	two consecutive listenings	three consecutive listenings	t
H. S.--Lit.	41.71	46.00	-	1.051
Elem.--Lit.	39.25	43.79	-	1.214
H. S.--Sci.	34.79	33.25	-	.423
Elem.--Sci.	21.46	23.54	-	.900

Note.--With 23 df (24 pairs in each group), 2.069 is required for t to be significant at the .05 level, 2.807 is required for significance at the .01 level.

It can be seen that in five of the eight groups learning resulting from multiple listenings exceeded that resulting from one reading of the same material by 10% or more; however, in no group did the difference in the means for learning under the two conditions approach statistical significance when evaluated by t tests. Therefore, it does not appear to matter, in terms of efficient use of study time, whether a student reads his material once or listens to it two or more times consecutively. In view of the findings in part one that consecutive listening may degrade learning performance of elementary students, a comparison of performance with distributed practice is of interest. Appropriate data are only available for the braille students. Analysis of these results indicated that elementary students, listening under distributed practice an equivalent time to that required for reading, do learn significantly more literature but no more science. Comparative means for literature are: reading once 37.46 and listening in distributed fashion three times 47.04. Comparable means for science are 26.75 and 29.92.

Part Four

Learning through Listening when Practice Is Massed and Distributed

The procedure used in the research reported in part one required subjects to listen to their subject matter either one, two, or three times consecutively with only brief breaks between presentations. For those hearing the material two and three times, this procedure resulted in massed practice during restricted periods of time.

The procedure used in the research reviewed in part two provided for distributed practice. In these studies, students either read or heard their material once or once on each of three consecutive days, the latter resulting in distributed practice.

The purpose of part four of this report is to compare learning resulting from massed practice (three consecutive listenings) with that resulting from distributed practice (three-day) in order to determine the technique best suited for study by visually handicapped students. Findings from the field of learning (McGeoch & Irion, 1952) would lead to the prediction that practice distributed over three days would result in more learning than that resulting from massed practice.

The materials used in the studies reported in parts one and two were the same and the structure of the subject groups was similar making it possible to compare the results of the two types of practice. The only important difference in the way the two sets of studies were designed was that subjects in the studies employing massed practice were offered a chance to win small tangible rewards whereas those in the studies employing distributed practice were not motivated beyound the usual plea for cooperation.

Factorial designs were used to compare data resulting from massed and distributed practice. The analyses were of the 2 X 2 X 2 type for the high school groups and of the 2 X 2 X 2 X 3 type for the elementary groups. Treatments under study were method (massed or distributed practice), practice (one or three exposures to the material), and type (braille or print reader). With the elementary groups a grade level factor was included, these being grades 4, 5, and 6. Separate analyses were run for high school literature, elementary literature, high school science, and elementary science and are presented in tables 18, 19, 21, and 22, respectively. Means and standard deviations for the two literature studies are presented in Table 20 and for the two science studies in Table 23.

Results

TABLE 18

Literature

Massed and Distributed Practice

High School Analysis of Variance Summary

Source of Variation	df	Sums of Squares	Mean Squares	F
Method (M)	1	136.69	136.69	.92
Practice (P)	1	5,764.08	5,764.08	38.99**
Type (T)	1	33.33	33.33	.23
M X P	1	80.09	80.09	.54
M X T	1	36.75	36.75	.25
P X T	1	20.03	20.03	.14
M X P X T	1	99.18	99.18	.67
Within Cells	184	27,200.33	147.83	
Total	191	33,370.48		

** Significant at .01 level (6.78 with 1 df)

TABLE 19

Literature

Massed and Distributed Practice

Elementary Analysis of Variance Summary

Source of Variation	df	Sums of Squares	Mean Squares	F
Method (M)	1	68.88	68.88	.47
Practice (P)	1	1,627.51	1,627.51	11.20**
Type (T)	1	563.76	563.76	3.88
Grade Level (GL)	2	1,910.17	955.08	6.57**
M X P	1	1,338.79	1,338.79	9.21**
M X T	1	84.00	84.00	.58
M X GL	2	827.54	413.77	2.58
P X T	1	7.91	7.91	.05
P X GL	2	40.53	20.26	.14
T X GL	2	301.16	150.58	1.04
M X P X T	1	13.56	13.56	.09
M X P X GL	2	703.64	351.82	2.42
P X T X GL	2	338.64	169.32	1.17
T X GL X M	2	14.30	7.15	.05
M X P X T X GL	2	49.86	24.93	.17
Within Cells	168	24,412.62	145.31	
Total	191	32,302.87		

** Significant at .01 level (6.79 with 1 df, 4.74 with 2 df)

TABLE 20

Literature

Massed and Distributed Practice

Summary Table of Means and Standard Deviations

	Massed Practice				Distributed Practice			
	One		Three		One		Three	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
				High School				
Braille	37.96	11.46	52.29	13.58	39.88	11.83	48.75	10.98
Print	41.75	14.40	51.92	10.28	39.04	12.70	49.50	11.50
				Elementary				
Braille								
grade 4	44.62	15.71	37.88	7.18	30.12	12.35	43.62	9.68
grade 5	30.62	16.40	41.62	10.27	37.62	14.64	46.12	9.93
grade 6	50.00	7.56	47.75	11.13	42.88	14.83	51.38	10.95
total	41.75	15.62	42.42	10.14	36.88	14.39	47.04	10.29
Print								
grade 4	38.38	10.81	35.75	12.80	27.62	11.88	41.62	15.68
grade 5	33.75	13.93	35.75	14.65	39.88	10.82	44.75	13.34
grade 6	39.25	11.67	41.12	8.32	34.06	9.04	51.25	8.75
total	37.12	11.92	37.54	11.96	33.83	11.38	45.88	13.00

TABLE 21

Science

Massed and Distributed Practice

High School Analysis of Variance Summary

Source of Variation	df	Sums of Squares	Mean Squares	F
Method (M)	1	16.33	16.33	.09
Practice (P)	1	1,716.02	1,716.02	9.05**
Type (T)	1	1,610.08	1,610.08	8.49**
M X P	1	234.09	234.09	1.23
M X T	1	188.03	188.03	.99
P X T	1	.76	.76	.00
M X P X T	1	2.50	2.50	.01
Within Cells	184	34,905.17	189.70	
Total	191	38,672.98		

** Significant at .01 level (6.78 with 1 df)

TABLE 22

Science

Massed and Distributed Practice

Elementary Analysis of Variance Summary

Source of Variation	df	Sums of Squares	Mean Squares	F
Method (M)	1	20.67	20.67	.19
Practice (P)	1	259.01	259.01	2.42
Type (T)	1	240.76	240.76	2.25
Grade Level (GL)	2	2,677.60	1,338.80	12.51**
M X P	1	550.13	550.13	5.14*
M X T	1	227.50	227.50	2.13
M X GL	2	184.03	92.02	.86
P X T	1	29.29	29.29	.27
P X GL	2	92.31	46.16	.43
T X GL	2	35.75	17.88	.17
M X P X T	1	15.76	15.76	.15
M X P X GL	2	200.02	100.01	.93
P X T X GL	2	4.05	2.02	.02
T X GL X M	2	104.08	52.04	.49
M X P X T X GL	2	294.49	147.24	1.38
Within Cells	168	17,972.38	106.98	
Total	191	22,907.83		

* Significant at .05 level (3.90 with 1 df, 3.05 with 2 df)

** Significant at .01 level (6.79 with 1 df, 4.74 with 2 df)

TABLE 23

Science

Massed and Distributed Practice

Summary Table of Means and Standard Deviations

	Massed Practice				Distributed Practice			
	One		Three		One		Three	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
				High School				
Braille	35.08	13.10	43.62	16.76	40.08	12.55	43.75	12.95
Print	31.62	12.20	39.46	16.64	32.21	12.03	36.08	13.01
				Elementary				
Braille								
grade 4	21.50	7.29	17.38	4.24	19.12	6.60	26.50	9.21
grade 5	25.50	14.61	30.12	9.09	26.12	11.62	26.25	11.89
grade 6	28.88	10.09	29.25	11.16	26.75	12.89	37.00	18.63
total	25.29	11.03	25.58	10.19	24.00	10.83	29.92	14.17
Print								
grade 4	22.00	5.13	22.50	12.81	16.50	4.21	17.75	3.37
grade 5	27.62	10.61	23.75	12.76	19.00	4.34	23.88	11.46
grade 6	30.12	11.22	26.25	9.36	23.88	8.25	34.25	11.37
total	26.58	9.62	24.17	11.34	19.79	6.45	25.29	11.45

High School literature. Of the major effects being tested, only practice proved significant for this group. As expected, increased practice yielded significantly (.01 level) greater learning. None of the other main effects nor their interactions even approached significance. These data are presented graphically in Figure 1.

Elementary literature. As with the high school literature group, practice effects were significantly different at the .01 level with those elementary students having more practice learning more. Differences significant at the .01 level were also found between grade levels with those in the higher grades learning more. Although method, of itself, was not a significant main effect, its interaction with practice accounted for differences significant at the .01 level. With massed practice, learning resulting from three exposures to the material was only slightly greater than that resulting from one exposure whereas when practice was distributed, additional practice resulted in much greater learning. These effects are presented graphically in Figure 2.

High school science. Differences significant at the .01 level were found for both practice and type with this group. The practice difference favored three exposures to the material and the type difference favored braille readers. No differences occurred between the two practice methods nor for any of the interactions. These data are presented graphically in Figure 3.

Elementary science. Grade level differences, favoring the higher grades, were significant at the .01 level for this group. The main effects of type, practice, and method were not responsible for significant differences in performance although the interaction between the latter two was significant at the .05 level. As with the elementary literature group, with massed practice learning resulting from three exposures to the material was only slightly greater than that resulting from one exposure, whereas with distributed practice, additional practice resulted in much greater learning. These results are presented graphically in Figure 4.

Figure 1

A Comparison of Learning Achieved under Practice Conditions of Distributed Reading, Distributed Listening, and Massed Listening High School Literature

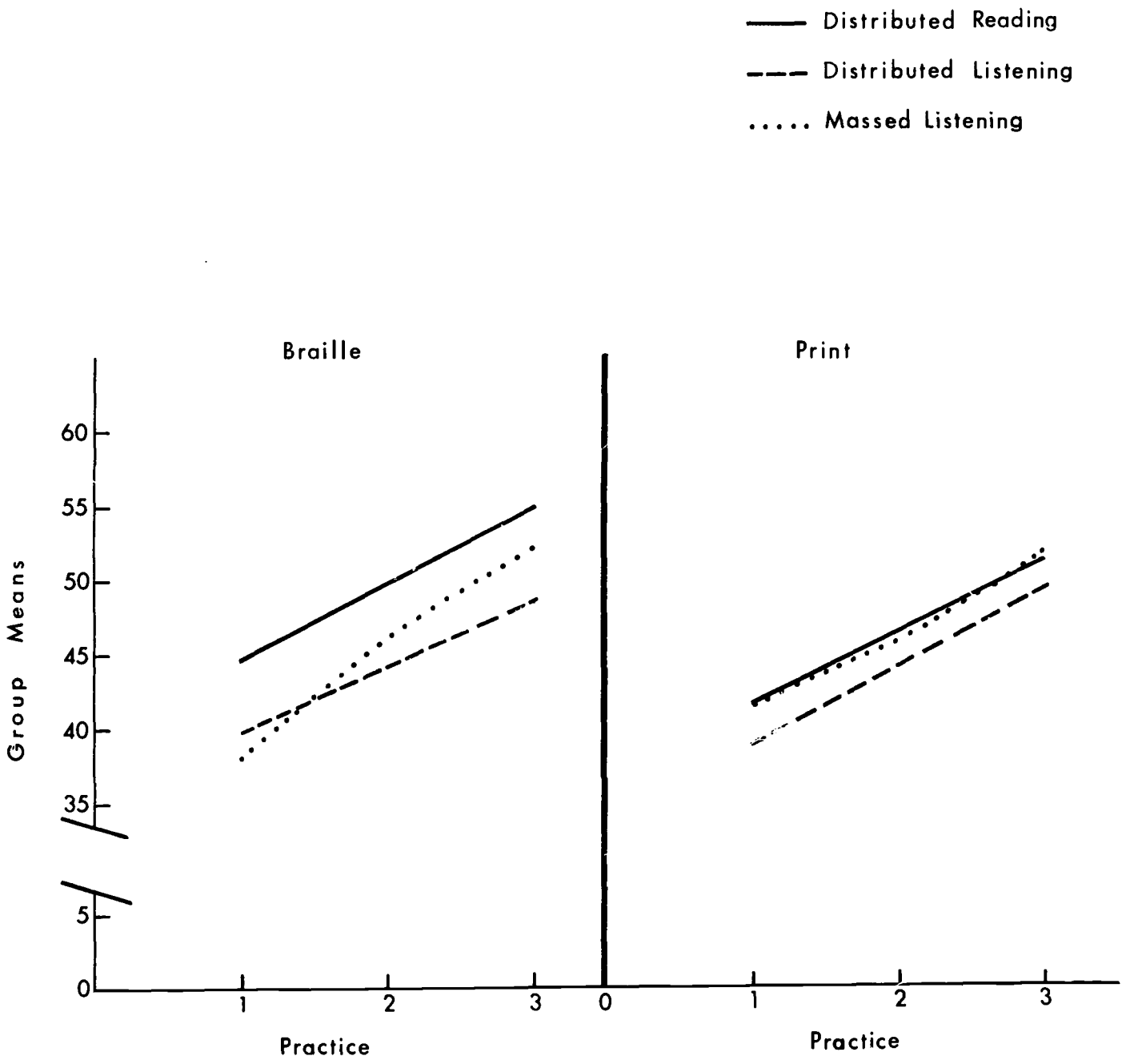


Figure 2

A Comparison of Learning Achieved under Practice Conditions of Distributed Reading, Distributed Listening, and Massed Listening

High School Science

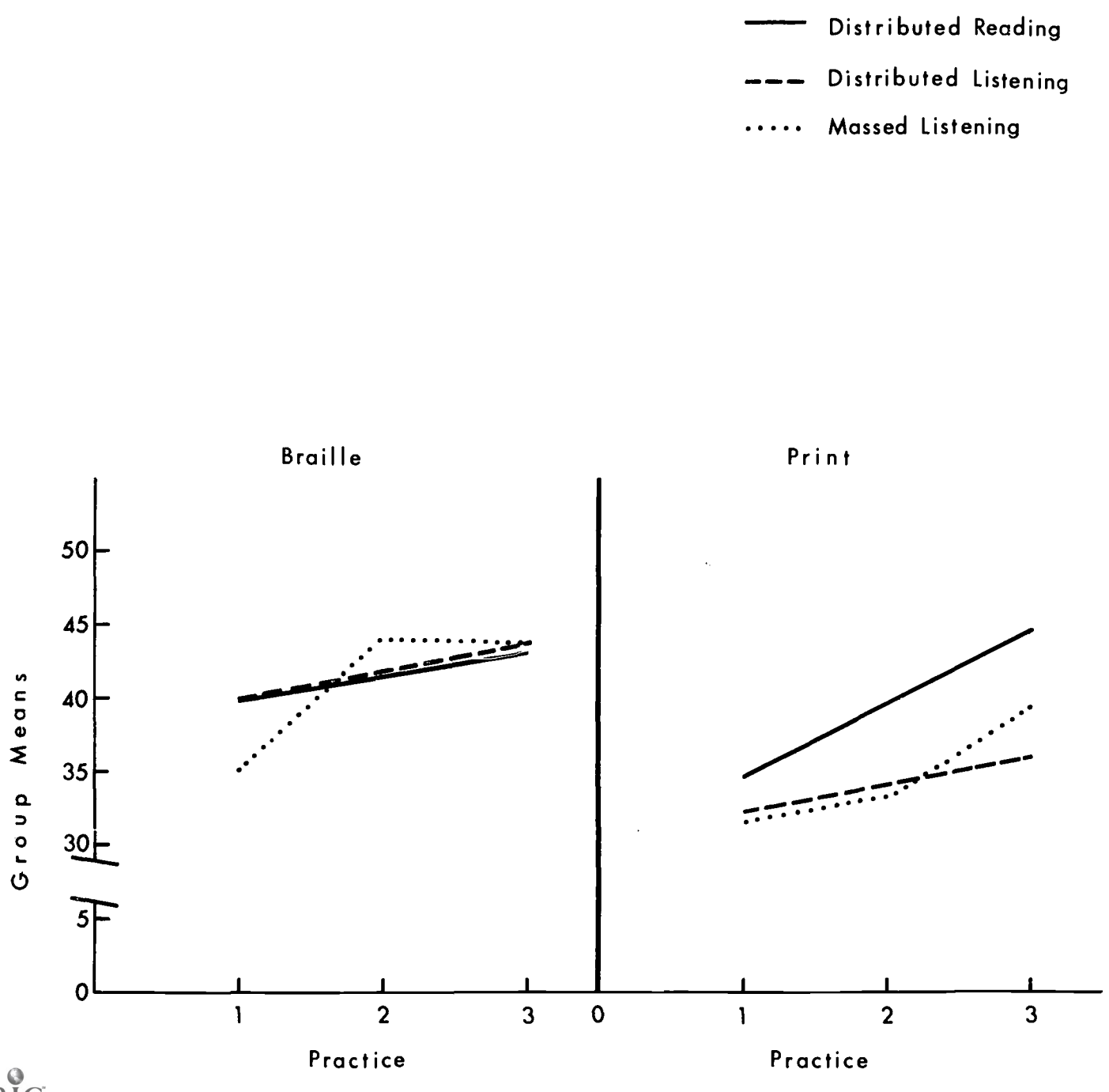


Figure 3

A Comparison of Learning Achieved under Practice Conditions of Distributed Reading, Distributed Listening, and Massed Listening Elementary Literature

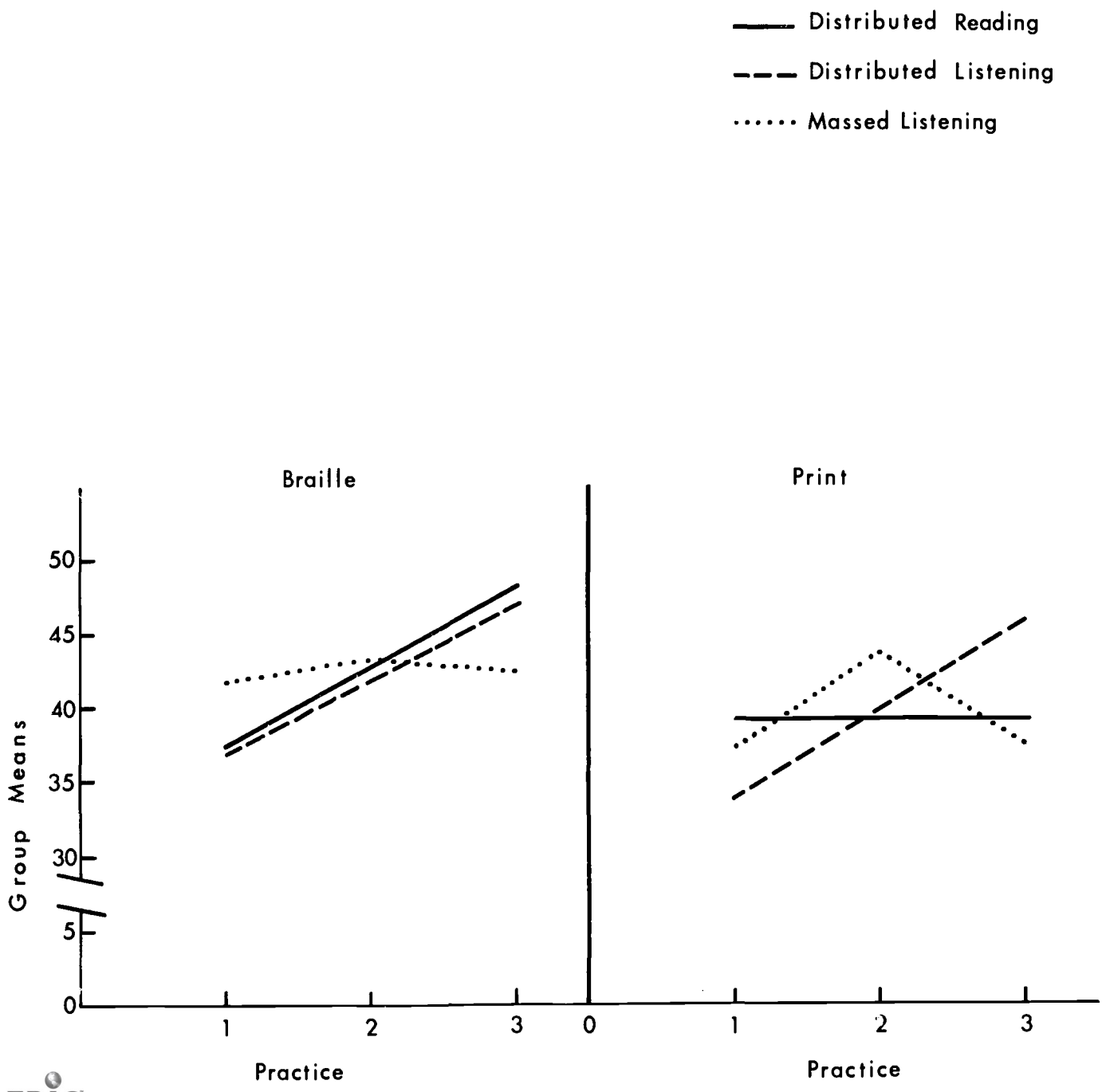
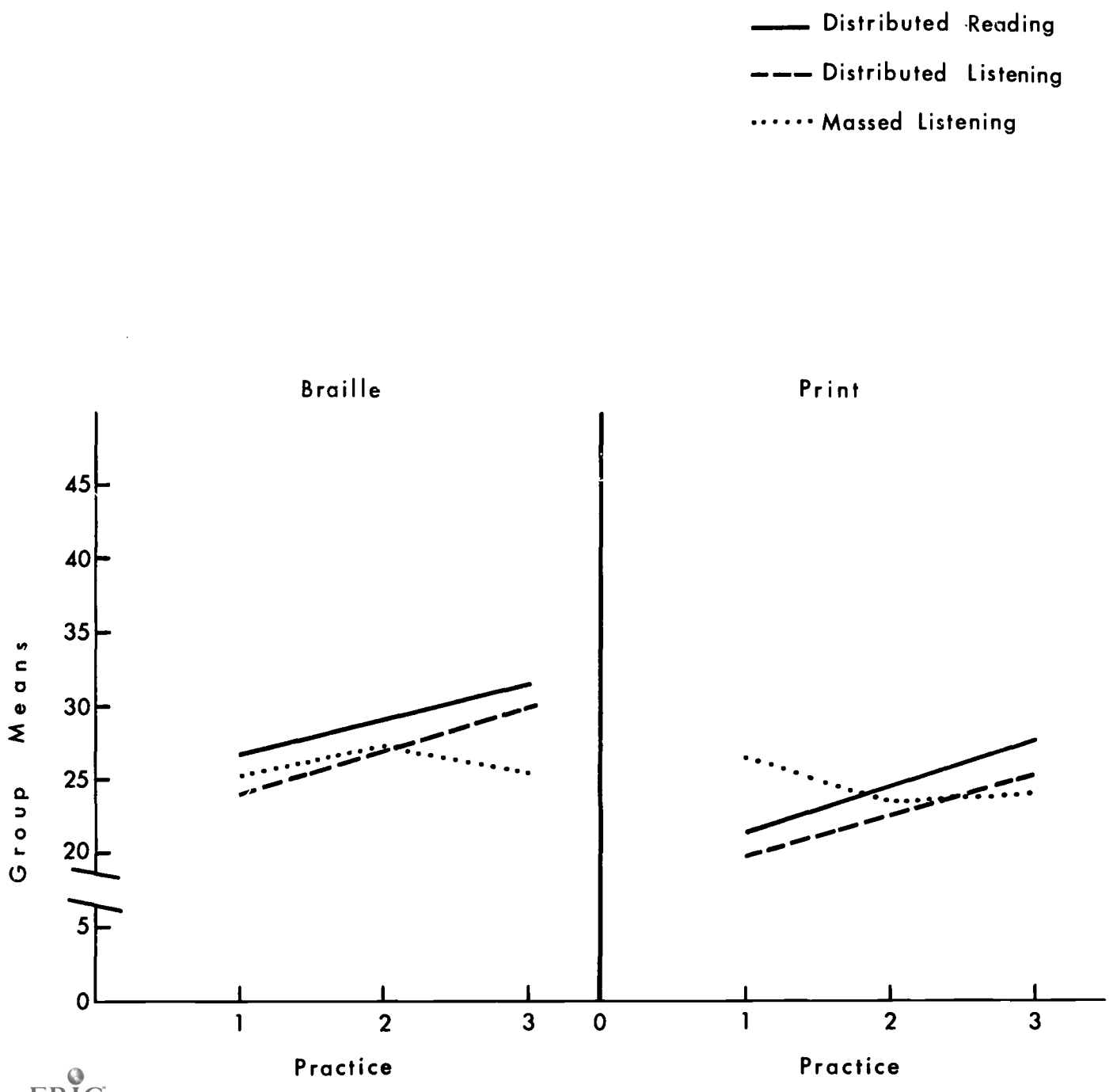


Figure 4

A Comparison of Learning Achieved under Practice Conditions of Distributed Reading, Distributed Listening, and Massed Listening Elementary Science



Discussion and Conclusions

No difference was found between learning resulting from massed or distributed practice for either easy or difficult material for high school level students. Increased learning did occur as a result of increased practice for both kinds of material with these students. Braille students learned significantly more of the difficult (science) material than did print students although there was no significant difference between the two groups for learning of the easier (literature) subject material. As mentioned in part two where similar findings were reported, it is possible that the braille students may have been more intelligent than the print students or possibly braille students are more skillful at interpreting oral material as they are more dependent on this mode of communication and more practiced in acquiring aural information. In either case, real differences between the two types of readers would be more likely to show up with the more difficult material and they did.

Past experience had led to the expectation that grade level differences would be found for elementary level students. Such differences were found for both kinds of material and were in the expected direction; namely, that students in higher grades generally were found to learn more than those in lower grades.

For literature, practice overall proved to be significantly and positively related to learning. With the science material, additional practice did not bring about an overall increase in learning. With both types of subject matter, a significant interaction between method and practice occurred with elementary level students. This was a result of the fact that with massed practice, learning did not change much as a result of additional practice. Where practice was distributed over a three day period considerable additional learning resulted.

Part Five

Conclusions

Findings resulting from the integration of information presented in the preceding parts yield an interesting portrayal of the process of learning via listening.

In the case of high school students, learning increased significantly with practice regardless of whether the practice was distributed or massed. Although there were no statistically significant differences resulting from the two types of practice, greater improvement in learning between one and three exposures to the material appeared to result from massed practice. Additionally, maximum learning resulting from listening occurred as a result of massed practice.

In the case of elementary students, learning was found to be positively related to practice, only when the practice was distributed. There was some evidence that learning was negatively related to practice when practice was massed although no statistically significant differences were found for learning resulting from different amounts of practice under this condition. Greater improvement in learning between one and three exposures to the material resulted from distributed practice and maximum learning, where study was by listening, tended to result from distributed practice. Learning resulting from both massed and distributed practice was found to be significantly and positively related to grade assignment.

In all previous instances, where efficiency of learning was computed in terms of learning per unit of time, listening proved to be a more efficient mode of study than reading. In present research when study time for reading and massed listening was held approximately constant, listening again tended to be a more efficient mode of learning than reading although these differences did not reach statistical significance. For elementary braille readers, equating study time for reading and listening resulted in significantly greater learning for listening when listening practice was distributed.

Learning achieved by reading is pictorially compared with learning achieved by the two methods of listening in figures 1-4. Nolan (1966) reported that the differences between learning achieved through reading and listening (distributed) were significantly different for the high school literature group. In this group greater learning was achieved through reading. No significant differences were found for learning achieved through reading and listening (distributed) for the elementary literature, the high school science, or the elementary science groups. In terms of total learning, greater learning occurred for reading at both high school and elementary levels. However, this advantage was only slight and of little or no practical importance.

The findings of this research indicate that when studying literature or science visually handicapped students can learn as much and perhaps more by studying from aural material as they can by study through reading. Differences between high school and elementary groups show that high school students can study effectively for longer periods of time than can elementary level students. Both benefit by practice; however, elementary students benefit only if that practice is distributed.

These findings hold, of course, for the types of continuous passive listening behavior described. Use of more active listening techniques, such as described by Nolan (1968) could significantly increase the relative learning from listening.

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